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The
Geographical Journal.

No. 5. NOVEMBER, 1899. Vol. XIV.

THE ANTARCTIC EXPEDITIONS.*

By Sir CLEMENTS MARKHAM, K.C.B., President of the Royal Geographical Society of London.

The projected exploration of the regions beyond the antarctic circle will, it is hoped, be undertaken simultaneously by two well-equipped expeditions sent out by England and Germany, and it is clearly most desirable that a plan of co-operation should be arranged.

I propose in this communication to consider the geographical work that will be before the expedition; to explain the course pursued by the Royal Geographical Society of London in promoting the English enterprise and its present position; and to discuss the plans to be adopted for securing the results that are desired. Allowing for the enormous advantages we possess over our predecessor through the introduction of steam to its full extent, I do not disguise from myself that the undertaking is one of great difficulty and danger, and that a most serious responsibility devolves upon its promoters. I have used the word "predecessor" in the singular, because in point of fact there has, up to this time, only been one properly equipped antarctic expedition. Other exploring and whaling vessels have crossed the antarctic circle, and have gone as far as the ice allowed, or as their business seemed to require; but the ships of Sir James Ross were the only ones that were prepared for navigation *in* the ice, and the only sailing ships that have penetrated *through* the polar pack into the true antarctic region.

* Paper read at the International Geographical Congress, Berlin, September 29, 1899.

One expedition, consisting of two slow sailing-vessels, is our predecessor. It is true that that one expedition did splendid work, and made great discoveries; but its means were very limited. In two seasons Sir James Ross twice penetrated through the polar pack, in the third season he failed probably because the attempt was made too late. This is all that has yet been done, and it shows how vast and how important is the area to be explored.

I propose, with a view to greater clearness, in discussing the probable work to be done in the unknown region, to consider it as divided into *four quadrants*—two on the Australasian side, and two on the Cape Horn and Cape of Good Hope side.

To the first quadrant on the Australasian side, from 90° E. to 180°, I propose to give the name of VICTORIA, as it includes Victoria Land. In the second, from 180° to 90° W., Cook and Ross alone have penetrated beyond the 70th parallel. It includes above half of the known part of the great ice-barrier; but the only known land within it is Peter island, discovered by Bellingshausen in 1821. It might appropriately have the name of SIR JAMES ROSS. The first quadrant on the Cape Horn and Cape of Good Hope side extends from 90° W. to the meridian of Greenwich. It includes the winter quarters of Gerlache, islands seen by Bellingshausen, Biscoe, and Larsen, and the part of the southern ocean in which Weddell penetrated to 74° 15′ S. It might properly be called after WEDDELL. The fourth quadrant, or the second on the Cape Horn and Cape of Good Hope side, extends from the meridian of Greenwich to 90° E., and is the least known. Here the 70th parallel has never been crossed; and distant land on the antarctic circle has only been sighted; namely, Enderby Land and Kemp Land. This quadrant might receive the name of, provisionally, ENDERBY, or of *Valdivia* after the German ship which approached Enderby Land this year. We thus have the unknown region divided into four quadrants.

Australasian side.	VICTORIA, 90° E. to 180°,	meridians of	Australia and New Zealand.
	ROSS, 180° to 90° W.	„	Pacific ocean.
Cape Horn and Cape of Good Hope side.	WEDDELL, 90° W. to 0°	„	Cape Horn.
	ENDERBY, 0° to 90° E.	„	Cape of Good Hope.

The VICTORIA QUADRANT first presents, for examination, the lands sighted by Balleny and Dumont D'Urville from 118° E. to the Balleny islands in 162° E.; namely, Adelie and Sabrina lands. It has been conjectured that these lands form the coast of a continuous continent, because they were sighted on nearly the same parallel, near the antarctic circle. A reconnaissance south from the *Challenger's* furthest point, in 64° S., 94° 30′ E., another along

the antarctic circle, and a third south-west from the Balleny islands, would probably settle this question, and lead to numerous scientific results. Still more important work will await the explorers in Victoria Land. It is not certain whether the land from Cape Adare, in 71° 18′ S., to Cape Washington, in 74° 37′ S., is continuous with the Victoria Land of Mounts Erebus and Terror, or whether it is an island. No land was seen between Capes Washington and Gauss; but Sir James Ross believed it to be continuous, on account of the massive character of the mountains on either side. This question must be decided.

At the angle in 77° S., where the great volcano was seen by Ross, and near which the ice-barrier commences, there is an indentation of the coast, which was named McMurdo bay. It seems probable that anchorage may be found there, and that a station may be established, whence a travelling party or parties may explore the volcanic region and the edge of the ice-cap, and even undertake journeys in the direction of Ross's position of the magnetic pole, and southwards towards the south pole.

The organization of a land exploring party will require very careful consideration. It is most likely that the travelling will be over glaciers, with some mountain climbing. The low atmospheric pressure maintained in all seasons south of 40° S. has led to the conjecture that a large anti-cyclone, with a higher pressure, overspreads the area south of 74° S., where the precipitation will not be so excessive. In that case it is possible that the conditions for travelling will not be intolerable. The country will, however, be without resources, and the most exact calculations must be made with regard to provisions, loads to be drawn, depôts, and weights.

In recent times much reliance has been placed upon dogs for arctic travelling. Yet nothing has been done with them to be compared with what men have achieved without dogs. Indeed, only one journey of considerable length has ever been performed, in the arctic regions, with dogs—that by Mr. Peary across the inland ice of Greenland. But he would have perished without the resources of the country, and all his dogs, but one, died owing to overwork, or were killed to feed the others. It is a very cruel system, and dogs are useless in rough ice or on broken ground. Men, on the other hand, are good everywhere, and the amount of provisions required by them, to go for a certain number of days and return, can be exactly calculated with regard to the weight to be drawn by each man. Sir Leopold M'Clintock in 1853, during an absence from his base of one hundred and five days, led a party of six men over 1210

miles at a rate of 10·4 miles a day, partly across land, partly over heavy ice. In 1854, after a second winter, Lieutenant Mecham, during seventy days, travelled over 1157 miles, much of it over very heavy rough ice, at the extraordinary rates of 16 miles a day out, and 20½ miles a day, for thirty-three days, in returning. He had seven men who were each dragging 255 lbs. at starting.

With such leaders as M'Clintock and Mecham, and such men as served under them, it will be seen that the distance of Ross's magnetic pole from McMurdo bay and back could very easily be covered in three months, without the cruelty of killing a team of dogs by overwork and starvation. The scientific value of the results obtained by such a party would be very great. If, as seems probable, the volcanic mass, culminating in Mount Erebus, rises from the plain on which the ice-barrier rests, not only might the volcanic region be explored, but the character and rate of motion of the ice-cap might be ascertained by borings, and other methods of measurement.

The ice-barrier, probably 1600 feet in perpendicular height, of which 150 to 200 feet are above the sea, would receive careful examination from the ship, with the aid of a captive balloon.

The Ross Quadrant (180° to 90° W.) contains the continuation of the ice-barrier, and a principal aim of the expedition would be to ascertain its extent, and the outline of the continental land on the Pacific side; as well as to make a determined effort to explore it, as far as the meridian of Peter island.

The Weddell Quadrant (90° W. to 0) invites discoveries of peculiar interest, including the southern side of Graham Land if it proves to be an island, and still more valuable discoveries if it is found to be a promontory extending from continental land. Sir John Murray, in a paper read before the Royal Geographical Society on November 27, 1893, adduced some reasons for thinking that on this side of the antarctic regions the land might partly consist of metamorphic and even sedimentary rocks. Soundings by Mr. Bruce indicated their presence. Fossils, probably of lower tertiary age, have been found on Seymour island; and Captain Larsen, of the Norwegian whaler *Jason*, picked up fossil coniferous wood on the east side of Graham Land. Holes were found perforated in this wood, filled with white lime, which led Sir Archibald Geikie to form the opinion that it had been driftwood. But whence came this driftwood of remote times, and what is the history of the ancient current which brought it, are questions of the deepest interest. These considerations show the importance of discovery southwards from Graham Land. There has been volcanic action on this Cape

Horn side, as well as on the Australian side, and Captain Larsen discovered an active volcano. Still, volcanic areas may, and probably do coexist with surrounding rocks of a metamorphic or sedimentary character.

In this quadrant, also, is the meridian of 35 W. down which Captain Weddell sailed in February, 1823, without obstruction from ice, to 74° 15′ S., and saw no icebergs and nothing to prevent his further progress. He was whaling, and returned because there was a south wind impeding his progress. It is conjectured that he was approaching land. If so, it was not a land bordered by the great ice-barrier, but a more accessible region which does not generate icebergs. Ross, in 1843, attempted to go south, a little to the east of Weddell's meridian, and encountered a pack which his ships could not penetrate; but it was a month later, in March. When Weddell made his southward voyage in February, the pack had not yet drifted north. The pack which Ross encountered in the Weddell sea, may not, however, be the result of a summer northern drift of the winter's ice. It is Sir Joseph Hooker's impression that it was too dense for that, and there was never a trace of water-blink over it. The pack appears to move over enormous areas of open sea, blocking them up for indefinite periods. Ross found 8 miles of pack blocking the approach to Cape Adare, where there was none this year. The same conclusion is to be derived from the positions in which the pack-ice was found by Bellingshausen and Balleny.

I am myself inclined to think that the continental land comes furthest north in 50° E. and 140° W.; and is much more to the south on the meridians of the Weddell Sea, and of the supposed continent of which Sabrina and Adelie lands are conjectured to be parts; though there are probably archipelagoes of islands. The isotherm of 32° Fahr. (0° Celsius) air-temperature in January and February is as far north as 54° S. on the meridian of Greenwich, and thence to 80° E., and also in the Pacific; while from 80° E. to 140° E., and from 45° W. to 90° W. the same isotherm is in 63° S. Where the isotherm comes furthest south, the region must be warmer, and colder where it goes north to 54° S. It is possible that this may be caused by the proximity or distance of frozen land-masses, in which case the form of the antarctic continent would be as I have indicated.

However this may be, what has been called the "Weddell Sea" certainly offers a splendid field for research and discovery; and an expedition penetrating in this direction should be prepared to land a well-equipped party to explore this side of the continent.

The ENDERBY QUADRANT, from 0° to 90 °E., has only been entered by Biscoe in February, 1831, who discovered Enderby Land. Captain Cook just crossed the antarctic circle in 1773, as did Moore in 1845 at nearly the same place, and the *Challenger* in 1874. All to the south of the antarctic circle, in this quadrant, is absolutely unknown, and invites discovery. Yet some indications of the nature of the land in this quadrant were obtained by the *Valdivia* when she approached Enderby Land this year, in the shape of specimens of gneiss, granite, schist, and red sandstone. Here I cannot refrain from offering my congratulations to my German colleagues on the admirable skill and ability with which the *Valdivia* expedition was conducted, and on its success.

It will be seen that the four quadrants into which, for convenience of description, I have divided the antarctic regions, all present problems of intense interest and vast areas for discovery.

The vessel which prosecutes the proposed discoveries will take magnetic and meteorological observations, and deep-sea soundings and dredgings as frequently as is compatible with the main objects of the expedition; which will be "to determine, as far as is possible, the extent and nature of the south polar land, to ascertain the nature of its glaciation, and to take magnetic and meteorological observations." *

In November, 1893, the President and Council of the Royal Geographical Society of London determined to promote the cause of antarctic exploration in earnest, with a determination to persevere until the object was attained. It was felt that a thoroughly efficient expedition must consist of two vessels commissioned by the Government, officered and manned by the navy, and under naval discipline. After a considerable lapse of time our Government came to a decision, and declined to undertake an enterprise of such magnitude. The Geographical Society, having secured the co-operation of the Royal Society and the approval of all the other scientific bodies of the kingdom, then resolved to appeal to its Fellows for funds to enable an antarctic expedition of less magnitude, consisting of one vessel, to be fitted out, if sufficient funds could not be collected for two vessels. The appeal was made, and the result up to the present date has been a subscription of £40,000.

* Report of the R.G.S. Antarctic Committee, consisting of Sir Joseph Hooker, Sir Clements Markham, Sir Leopold M'Clintock, Sir R. Vesey Hamilton, Sir George Nares, Sir William Wharton, Sir Erasmus Ommanney, Sir John Murray.

One generous and public-spirited Fellow of the Royal Geographical Society, Mr. Longstaff, subscribed a sum of £25,000. The enterprise was cordially supported by the press, and, seeing the importance that was attached to it by public opinion, H.M. Government has been induced to grant annual sums so as to double the amount raised by private subscriptions.

During the six years that have elapsed since the Geographical Society of London began its antarctic crusade in 1893, the subject has been very carefully studied in all its details. The known facts have been collected and compared respecting antarctic meteorology; the character and position of the south polar pack in different seasons, and in different times of the same season, have been considered; and comparisons have been made between the ice and ice-navigation in the arctic and antarctic regions. These materials have led us to decisions respecting the vessel and its equipment, the organization of land-parties, and the general scheme of work for the expedition; with reference to the funds at present at our disposal.

The vessel for the expedition will be built of oak, with ice-casing of greenheart, or of some other harder wood. She will be 172 feet long by 33 broad, with a displacement of about 1570 tons. She will carry 240 tons of coal, and will have an engine of 450 horse-power. The bows will be specially strengthened, sharp, and overhanging for charging the ice and forcing a way through it. The stern and counters will be designed for giving as much protection as possible to the rudder and propeller, which will be fitted for raising quickly. The engine will be right aft, so as to admit of a magnetic observatory being built before the mainmast, which shall have no iron within 30 feet. Melbourne will be the base for magnetic observations. Provision will also be made for deep-sea sounding and dredging; there will be two houses on deck for biological work, and a laboratory below. There will be accommodation for six executive officers, including an engineer, three civilians for physical and chemical research, for biology and geology, including the surgeon, and thirty-nine men. The scientific staff will consist of the captain and leader of the expedition, and of four officers, who will have charge of the navigation, celestial, meteorological, and magnetic observations, surveys, and deep-sea sounding and dredging; and of three civilians.

The ship will be prepared for wintering, and extensive land journeys are contemplated.

I presume that, the objects being identical, the vessel and

arrangements of the German expedition will be analogous. The most valuable form that co-operation can take will be the exploration of so much as is possible of all the four quadrants into which I have divided the unknown region, two being taken by the English, and two by the German expedition. Another valuable result of co-operation will be the series of simultaneous meteorological observations.

All the four quadrants present work of the highest value, or I should rather say that all present equal opportunities for penetrating into the unknown, and for making discoveries of the greatest value to science, and which combined will materially increase our knowledge.

On the antarctic map which was sent to us from Berlin some months ago, two lines were drawn to show the suggested routes of the English and German expeditions. The English line extends from 90° E. to 90° W., and the German line from 90° W. to 90° E. In other words, the suggestion is that the English should take the Victoria and Ross quadrants, and the Germans the Weddell and Enderby quadrants.

I do not see how this suggestion could be improved, with a view to the most comprehensive and useful co-operation between the two expeditions. In the event of its adoption, both expeditions would start from the Thames and the Elbe in August, 1901. The English vessel would go to her magnetic base at Melbourne. Thence she would proceed to the exploration of the islands or continental land from 90° to the Balleny islands. This completed so far as may be possible, she would press on through the polar pack, examine the gap between Capes Washington and Gauss of Victoria Land, and establish the landing-party in McMurdo bay, at the foot of Mount Erebus. She would then return to her magnetic base, and afterwards proceed to Lyttleton, in New Zealand, to winter, as a more convenient starting-point.

In the second season the English vessel would force her way direct to McMurdo bay, take the landing party on board, and then examine the ice-barrier for its known length of 300 miles, and as far eastward and westward as the season will allow beyond that, again returning to Melbourne, then to Lyttleton. A captive balloon will be of material assistance in ascertaining the nature of the ice-barrier.

In the third season, if the funds admit of its being entered upon, a resolute and sustained effort would be made to continue the discovery of the line either of the ice-barrier or of the

continental coast, whichever it proves to be, along the Pacific to the meridian of Peter island.

Magnetic observations, deep-sea soundings, and dredgings would be taken throughout the three seasons; but, looking to the uncertain movements of the pack-ice, and to our ignorance of the conditions obtaining over the unknown area, a very wide discretion will be given to the leader of the expedition.

Simultaneously, the German expedition would proceed to its station at Kerguelen island, and thence to the scene of its labours, and, we hope, its discoveries. The ENDERBY or VALDIVIA and WEDDELL quadrants certainly comprise investigations of equal importance, including the discovery of that part of the continental land south of the Weddell sea, which is believed to comprise rocks other than volcanic. Here a landing-party will have work of even greater interest than that which lands in McMurdo bay. But it is not for me even to outline the contemplated German exploration, which has, doubtless, already been systematically planned by the able advisers of the expedition.

I believe that this great geographical enterprise is one of the most important that has ever been conceived. It will add largely to the sum of human knowledge, and, in many ways, will be of direct benefit to mankind. It is a beneficent work, a work which makes for peace and good fellowship among nations. It must rejoice the hearts of all geographers that the countrymen of Humboldt, of Ritter, of Kiepert, of Richthofen, and of Neumayer should combine with the countrymen of Banks, of Rennell, of Murchison, and of Sabine to achieve a grand scientific work which will redound to the honour of both nations.

THE GEOGRAPHICAL CYCLE.

By WILLIAM M. DAVIS, Professor of Physical Geography in Harvar University.

THE GENETIC CLASSIFICATION OF LAND-FORMS.—All the varied forms of the lands are dependent upon—or, as the mathematician would say, are functions of—three variable quantities, which may be called structure, process, and time. In the beginning, when the forces of deformation and uplift determine the structure and attitude of a region, the form of its surface is in sympathy with its internal arrangement, and its height depends on the amount of uplift that it has suffered. If its rocks were unchangeable under the attack of external processes, its surface would remain unaltered until the forces of deformation and uplift acted again;

and in this case structure would be alone in control of form. But no rocks are unchangeable; even the most resistant yield under the attack of the atmosphere, and their waste creeps and washes downhill as long as any hills remain; hence all forms, however high and however resistant, must be laid low, and thus destructive process gains rank equal to that of structure in determining the shape of a land-mass. Process cannot, however, complete its work instantly, and the amount of change from initial form is therefore a function of time. Time thus completes the trio of geographical controls, and is, of the three, the one of most frequent application and of most practical value in geographical description.

Structure is the foundation of all geographical classifications in which the trio of controls is recognized. The Alleghany plateau is a unit, a "region," because all through its great extent it is composed of widespread horizontal rock-layers. The Swiss Jura and the Pennsylvanian Appalachians are units, for they consist of corrugated strata. The Laurentian highlands of Canada are essentially a unit, for they consist of greatly disturbed crystalline rocks. These geographical units have, however, no such simplicity as mathematical units; each one has a certain variety. The strata of plateaus are not strictly horizontal, for they slant or roll gently, now this way, now that. The corrugations of the Jura or of the Appalachians are not all alike; they might indeed, be more truly described as all different, yet they preserve their essential features with much constancy. The disordered rocks of the Laurentian highlands have so excessively complicated a structure as at present to defy description, unless item by item; yet, in spite of the free variations from a single structural pattern, it is legitimate and useful to look in a broad way at such a region, and to regard it as a structural unit. The forces by which structures and attitudes have been determined do not come within the scope of geographical inquiry, but the structures acquired by the action of these forces serve as the essential basis for the genetic classification of geographical forms. For the purpose of this article, it will suffice to recognize two great structural groups: first, the group of horizontal structures, including plains, plateaus, and their derivatives, for which no single name has been suggested; second, the group of disordered structures, including mountains and their derivatives, likewise without a single name. The second group may be more elaborately subdivided than the first.

The destructive processes are of great variety—the chemical action of air and water, and the mechanical action of wind, heat, and cold, of rain and snow, rivers and glaciers, waves and currents. But as most of the land surface of the Earth is acted on chiefly by weather changes and running water, these will be treated as forming a normal group of destructive processes; while the wind of arid deserts and the ice of

frigid deserts will be considered as climatic modifications of the norm, and set apart for particular discussion; and a special chapter will be needed to explain the action of waves and currents on the shore-lines at the edge of the lands. The various processes by which destructive work is done are in their turn geographical features, and many of them are well recognized as such, as rivers, falls, and glaciers; but they are too commonly considered by geographers apart from the work that they do, this phase of their study being, for some unsatisfactory reason, given over to physical geology. There should be no such separation of agency and work in physical geography, although it is profitable to give separate consideration to the active agent and to the inert mass on which it works.

Time as an Element in Geographical Terminology.—The amount of change caused by destructive processes increases with the passage of time, but neither the amount nor the rate of change is a simple function of time. The amount of change is limited, in the first place, by the altitude of a region above the sea; for, however long the time, the normal destructive forces cannot wear a land surface below this ultimate baselevel of their action; and glacial and marine forces cannot wear down a land-mass indefinitely beneath sea-level. The rate of change under normal processes, which alone will be considered for the present, is at the very first relatively moderate; it then advances rather rapidly to a maximum, and next slowly decreases to an indefinitely postponed minimum.

Evidently a longer period must be required for the complete denudation of a resistant than of a weak land-mass, but no measure in terms of years or centuries can now be given to the period needed for the effective wearing down of highlands to featureless lowlands. All historic time is hardly more than a negligible fraction of so vast a duration. The best that can be done at present is to give a convenient name to this unmeasured part of eternity, and for this purpose nothing seems more appropriate than a "*geographical cycle*." When it is possible to establish a ratio between geographical and geological units, there will probably be found an approach to equality between the duration of an average cycle and that of Cretaceous or Tertiary time, as has been indicated by the studies of several geomorphologists.

"Theoretical" Geography.—It is evident that a scheme of geographical classification that is founded on structure, process, and time, must be deductive in a high degree. This is intentionally and avowedly the case in the present instance. As a consequence, the scheme gains a very "theoretical" flavour that is not relished by some geographers, whose work implies that geography, unlike all other sciences, should be developed by the use of only certain ones of the mental faculties, chiefly observation, description, and generalization. But nothing seems to me clearer than that geography has already suffered too long from

the disuse of imagination, invention, deduction, and the various other mental faculties that contribute towards the attainment of a well-tested explanation. It is like walking on one foot, or looking with one eye, to exclude from geography the "theoretical" half of the brain-power, which other sciences call upon as well as the "practical" half. Indeed, it is only as a result of misunderstanding that an antipathy is implied between theory and practice, for in geography, as in all sound scientific work, the two advance most amiably and effectively together. Surely the fullest development of geography will not be reached until all the mental faculties that are in any way pertinent to its cultivation are well trained and exercised in geographical investigation.

All this may be stated in another way. One of the most effective aids to the appreciation of a subject is a correct explanation of the facts that it presents. Understanding thus comes to aid the memory. But a genetic classification of geographical forms is, in effect, an explanation of them; hence such a classification must be helpful to the travelling, studying, or teaching geographer, provided only that it is a true and natural classification. True and natural a genetic classification may certainly be, for the time is past when even geographers can look on the forms of lands as "ready made." Indeed, geographical definitions and descriptions are untrue and unnatural just so far as they give the impression that the forms of the lands are of unknown origin, not susceptible of rational explanation. From the very beginning of geography in the lower schools, the pupils should be possessed with the belief that geographical forms have meaning, and that the meaning or origin of so many forms is already so well assured that there is every reason to think that the meaning of all the others will be discovered in due time. The explorer of the Earth should be as fully convinced of this principle, and as well prepared to apply it, as the explorer of the sky is to carry physical principles to the furthest reach of his telescope, his spectroscope, and his camera. The preparation of route-maps and the determination of latitude, longitude, and altitude for the more important points is only the beginning of exploration, which has no end till all the facts of observation are carried forward to explanation.

It is important, however, to insist that the geographer needs to know the meaning, the explanation, the origin, of the forms that he looks at, simply because of the aid thus received when he attempts to observe and describe the forms carefully. It is necessary clearly to recognize this principle, and constantly to bear it in mind, if we would avoid the error of confounding the objects of geographical and geological study. The latter examines the changes of the past for their own sake, inasmuch as geology is concerned with the history of the Earth; the former examines the changes of the past only so far as they serve to illuminate the present, for geography is concerned essentially with the Earth as it now exists. Structure is a pertinent element of geographical

study when, as nearly always, it influences form; no one would to-day attempt to describe the Weald without some reference to the resistent chalk layers that determine its rimming hills. Process is equally pertinent to our subject, for it has everywhere been influential in determining form to a greater or less degree, and it is everywhere in operation to-day. It is truly curious to find geographical text-books which accept the movement of winds, currents, and rivers as part of their responsibility, and yet which leave the weathering of the lands and the movement of land-waste entirely out of consideration. Time is certainly an important geographical element, for where the forces of uplift or deformation have lately (as the Earth views time) initiated a cycle of change, the destructive processes can have accomplished but little work, and the land-form is "young;" where more time has elapsed, the surface will have been more thoroughly carved, and the form thus becomes "mature;" and where so much time has passed that the originally uplifted surface is worn down to a lowland of small relief, standing but little above sea-level, the form deserves to be called "old." A whole series of forms must be in this way evolved in the life-history of a single region, and all the forms of such a series, however unlike they may seem at first sight, should be associated under the element of time, as merely expressing the different stages of development of a single structure. The larva, the pupa, and the imago of an insect; or the acorn, the full-grown oak, and the fallen old trunk, are no more naturally associated as representing the different phases in the life-history of a single organic species, than are the young mountain block, the maturely carved mountain-peaks and valleys, and the old mountain peneplain, as representing the different stages in the life-history of a single geographic group. Like land-forms, the agencies that work upon them change their behaviour and their appearance with the passage of time. A young land-form has young streams of torrential activity, while an old form would have old streams of deliberate or even of feeble current, as will be more fully set forth below.

The Ideal Geographical Cycle.—The sequence in the developmental changes of land-forms is, in its own way, as systematic as the sequence of changes found in the more evident development of organic forms. Indeed, it is chiefly for this reason that the study of the origin of land-forms—or geomorphogeny, as some call it—becomes a practical aid, helpful to the geographer at every turn. This will be made clearer by the specific consideration of an ideal case, and here a graphic form of expression will be found of assistance.

The base-line, $a\omega$, of Fig. 1 represents the passage of time, while verticals above the base-line measure altitude above sea-level. At the epoch 1, let a region of whatever structure and form be uplifted, B representing the average altitude of its higher parts, and A that of its lower parts; thus AB measuring its average initial relief. The surface

rocks are attacked by the weather. Rain falls on the weathered surface, and washes some of the loosened waste down the initial slopes to the trough-lines where two converging slopes meet; there the streams are formed, flowing in directions consequent upon the descent of the trough-lines. The machinery of the destructive processes is thus put in motion, and the destructive development of the region is begun. The larger rivers, whose channels initially had an altitude, A, quickly deepen their valleys, and at the epoch 2 have reduced their main channels to a moderate altitude, represented by C. The higher parts of the inter-stream uplands, acted on only by the weather without the concentration of water in streams, waste away much more slowly, and at epoch 2 are reduced in height only to D. The relief of the surface has thus been increased from AB to CD. The main rivers then deepen their channels very slowly for the rest of their life, as shown by the curve CEGJ; and the wasting of the uplands, much dissected by branch streams, comes to be more rapid than the deepening of the main valleys, as shown by comparing the curves DFHK and CEGJ. The period 3–4 is the time of the most rapid consumption of the uplands, and

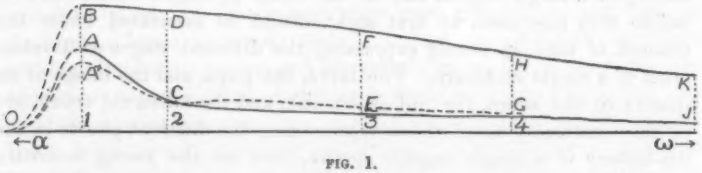

FIG. 1.

thus stands in strong contrast with the period 1–2, when there was the most rapid deepening of the main valleys. In the earlier period, the relief was rapidly increasing in value, as steep-sided valleys were cut beneath the initial troughs. Through the period 2–3 the maximum value of relief is reached, and the variety of form is greatly increased by the headward growth of side valleys. During the period 3–4 relief is decreasing faster than at any other time, and the slope of the valley sides is becoming much gentler than before; but these changes advance much more slowly than those of the first period. From epoch 4 onward the remaining relief is gradually reduced to smaller and smaller measures, and the slopes become fainter and fainter, so that some time after the latest stage of the diagram the region is only a rolling lowland, whatever may have been its original height. So slowly do the later changes advance, that the reduction of the reduced relief JK to half of its value might well require as much time as all that which has already elapsed; and from the gentle slopes that would then remain, the further removal of waste must indeed be exceedingly slow. The frequency of torrential floods and of landslides in young and in mature mountains, in contrast to the quiescence of the sluggish streams and the slow

movement of the soil on lowlands of denudation, suffices to show that rate of denudation is a matter of strictly geographical as well as of geological interest.

It follows from this brief analysis that a geographical cycle may be subdivided into parts of unequal duration, each one of which will be characterized by the strength and variety of relief, and by the rate of change, as well as by the amount of change that has been accomplished since the initiation of the cycle. There will be a brief youth of rapidly increasing relief, a maturity of strongest relief and greatest variety of form, a transition period of most rapidly yet slowly decreasing relief, and an indefinitely long old age of faint relief, on which further changes are exceedingly slow. There are, of course, no breaks between these subdivisions or stages; each one merges into its successor, yet each one is in the main distinctly characterized by features found at no other time.

THE DEVELOPMENT OF CONSEQUENT STREAMS.—The preceding section gives only the barest outline of the systematic sequence of changes that run their course through a geographical cycle. The outline must be at once gone over, in order to fill in the more important details. In the first place, it should not be implied, as was done in Fig. 1, that the forces of uplift or deformation act so rapidly that no destructive changes occur during their operation. A more probable relation at the opening of a cycle of change places the beginning of uplift at O (Fig. 1), and its end at 1. The divergence of the curves OB and OA then implies that certain parts of the disturbed region were uplifted more than others, and that, from a surface of no relief at sea-level at epoch O, an upland having AB relief would be produced at epoch 1. But even during uplift, the streams that gather in the troughs as soon as they are defined do some work, and hence young valleys are already incised in the trough-bottoms when epoch 1 is reached, as shown by the curve OA′. The uplands also waste more or less during the period of disturbance, and hence no absolutely unchanged initial surface should be found, even for some time anterior to epoch 1. Instead of looking for initial divides separating initial slopes that descend to initial troughs followed by initial streams, such as were implied in Fig. 1 at the epoch of instantaneous uplift, we must always expect to find some greater or less advance in the sequence of developmental changes, even in the youngest known land-forms. "Initial" is therefore a term adapted to ideal rather than to actual cases, in treating which the term "sequential" and its derivatives will be found more appropriate. All the changes which directly follow the guidance of the ideal initial forms may be called consequent; thus a young form would possess consequent divides, separating consequent slopes which descend to consequent valleys; the initial troughs being changed to consequent valleys in so far as their form is modified by the action of the consequent drainage.

The Grade of Valley Floors.—The larger rivers soon—in terms of the cycle—deepen their main valleys, so that their channels are but little above the baselevel of the region; but the valley floor cannot be reduced to the absolute baselevel, because the river must slope down to its mouth at the sea-shore. The altitude of any point on a well-matured valley floor must therefore depend on river-slope and distance from mouth. Distance from mouth may here be treated as a constant, although a fuller statement would consider its increase in consequence of delta-growth. River-slope cannot be less, as engineers know very well, than a certain minimum that is determined by volume and by quantity and texture of detritus or load. Volume may be temporarily taken as a constant, although it may easily be shown to suffer important changes during the progress of a normal cycle. Load is small at the beginning, and rapidly increases in quantity and coarseness during youth, when the region is entrenched by steep-sided valleys; it continues to increase in quantity, but probably not in coarseness, during early maturity, when ramifying valleys are growing by headward erosion, and are thus increasing the area of wasting slopes; but after full maturity, load continually decreases in quantity and in coarseness of texture; and during old age, the small load that is carried must be of very fine texture or else must go off in solution. Let us now consider how the minimum slope of a main river will be determined.

In order to free the problem from unnecessary complications, let it be supposed that the young consequent rivers have at first slopes that are steep enough to make them all more than competent to carry the load that is washed into them from the wasting surface on either side, and hence competent to entrench themselves beneath the floor of the initial troughs,—this being the condition tacitly postulated in Fig. 1, although it evidently departs from those cases in which deformation produces basins where lakes must form and where deposition (negative denudation) must take place, and also from those cases in which a main-trough stream of moderate slope is, even in its youth, over-supplied with detritus by active side streams that descend steep and long wasting surfaces; but all these more involved cases may be set aside for the present.

If a young consequent river be followed from end to end, it may be imagined as everywhere deepening its valley, unless at the very mouth. Valley-deepening will go on most rapidly at some point, probably nearer head than mouth. Above this point the river will find its slope increased; below, decreased. Let the part up-stream from the point of most rapid deepening be called the headwaters; and the part down-stream, the lower course or trunk. In consequence of the changes thus systematically brought about, the lower course of the river will find its slope and velocity decreasing, and its load increasing; that is, its ability to do work is becoming less, while the work that it has to do is becoming

greater. The original excess of ability over work will thus in time be corrected, and when an equality of these two quantities is brought about, the river is *graded*, this being a simple form of expression, suggested by Gilbert, to replace the more cumbersome phrases that are required by the use of "profile of equilibrium" of French engineers. When the graded condition is reached, alteration of slope can take place only as volume and load change their relation; and changes of this kind are very slow.

In a land-mass of homogeneous texture, the graded condition of a river would be (in such cases as are above considered) first attained at the mouth, and would then advance retrogressively up-stream. When the trunk streams are graded, early maturity is reached; when the smaller headwaters and side streams are also graded, maturity is far advanced; and when even the wet-weather rills are graded, old age is attained. In a land-mass of heterogeneous texture, the rivers will be divided into sections by the belts of weaker and stronger rocks that they traverse; each section of weaker rocks will in due time be graded with reference to the section of harder rock next down-stream, and thus the river will come to consist of alternating quiet reaches and hurried falls or rapids. The less resistant of the harder rocks will be slowly worn down to grade with respect to the more resistant ones that are further down stream; thus the rapids will decrease in number, and only those on the very strongest rocks will long survive. Even these must vanish in time, and the graded condition will then be extended from mouth to head. The slope that is adopted when grade is assumed varies inversely with the volume; hence rivers retain steep headwaters long after their lower course is worn down almost level; but in old age, even the headwaters must have a gentle declivity and moderate velocity, free from all torrential features. The so-called "normal river," with torrential headwaters and well-graded middle and lower course, is therefore simply a maturely developed river. A young river may normally have falls even in its lower course, and an old river must be free from rapid movement even near its head.

If an initial consequent stream is for any reason incompetent to carry away the load that is washed into it, it cannot degrade its channel, but must aggrade instead (to use an excellent term suggested by Salisbury). Such a river then lays down the coarser part of the offered load, thus forming a broadening flood-land, building up its valley floor, and steepening its slope until it gains sufficient velocity to do the required work. In this case the graded condition is reached by filling up the initial trough instead of by cutting it down. Where basins occur, consequent lakes rise in them to the level of the outlet at the lowest point of the rim. As the outlet is cut down, it forms a sinking local baselevel with respect to which the basin is aggraded; and as the lake is thus destroyed, it forms a sinking baselevel with respect to which the tributary streams grade their valleys; but, as in

the case of falls and rapids, the local baselevels of outlet and lake are temporary, and lose their control when the main drainage lines are graded with respect to absolute baselevel in early or late maturity.

The Development of River Branches. — Several classes of side streams may be recognized. Some of them are defined by slight initial depressions in the side slopes of the main river-troughs: these form lateral or secondary consequents, branching from a main consequent; they generally run in the direction of the dip of the strata. Others are developed by headward erosion under the guidance of weak substructures that have been laid bare on the valley walls of the consequent streams: they follow the strike of the strata, and are entirely regardless of the form of the initial land surface; they may be called subsequent, this term having been used by Jukes in describing the development of such streams. Still others grow here and there, to all appearance by accident, seemingly independent of systematic guidance; they are common in horizontal or massive structures. While waiting to learn just what their control may be, their independence of apparent control may be indicated by calling them "insequent." Additional classes of streams are well known, but cannot be described here for lack of space.

Relation of River Ability and Load.—As the dissection of a land-mass proceeds with the fuller development of its consequent, subsequent, and insequent streams, the area of steep valley sides greatly increases from youth into early and full maturity. The waste that is delivered by the side branches to the main stream comes chiefly from the valley sides, and hence its quantity increases with the increase of strong dissection, reaching a maximum when the formation of new branch streams ceases, or when the decrease in the slope of the wasting valley sides comes to balance their increase of area. It is interesting to note in this connection the consequences that follow from two contrasted relations of the date for the maximum discharge of waste and of that for the grading of the trunk streams. If the first is not later than the second, the graded rivers will slowly assume gentler slopes as their load lessens; but as the change in the discharge of waste is almost infinitesimal compared to the amount discharged at any one time, the rivers will essentially preserve their graded condition in spite of the minute excess of ability over work. On the other hand, if the maximum of load is not reached until after the first attainment of the graded condition by the trunk rivers, then the valley floors will be aggraded by the deposition of a part of the increasing load, and thus a steeper slope and a greater velocity will be gained whereby the remainder of the increase can be borne along. The bottom of the V-shaped valley, previously carved, is thus slowly filled with a gravelly flood-plain, which continues to rise until the epoch of the maximum load is reached, after which the slow degradation above stated is entered upon. Early maturity may therefore witness a slight shallowing of the main valleys,

instead of the slight deepening (indicated by the dotted line CE in Fig. 1); but late maturity and all old age will be normally occupied by the slow continuation of valley erosion that was so vigorously begun during youth.

THE DEVELOPMENT OF DIVIDES.—There is no more beautiful process to be found in the systematic advance of a geographical cycle than the definition, subdivision, and rearrangement of the divides (water-partings) by which the major and minor drainage basins are separated. The forces of crustal upheaval and deformation act in a much broader way than the processes of land-sculpture; hence at the opening of a cycle one would expect to find a moderate number of large river-basins, somewhat indefinitely separated on the flat crests of broad swells or arches of land surface, or occasionally more sharply limited by the raised edge of faulted blocks. The action of the lateral consequent streams alone would, during youth and early maturity, sharpen all the vague initial divides into well-defined consequent divides, and the further action of insequent and subsequent streams would split up many consequent drainage slopes into subordinate drainage basins, separated by subdivides either insequent or subsequent. Just as the subsequent valleys are eroded by their gnawing streams along weak structural belts, so the subsequent divides or ridges stand up where maintained by strong structural belts. However imperfect the division of drainage areas and the discharge of rainfall may have been in early youth, both are well developed by the time full maturity is reached. Indeed, the more prompt discharge of rainfall that may be expected to result from the development of an elaborate system of subdivides and of slopes from divides to streams should cause an increased percentage of run-off; and it is possible that the increase of river-volume thus brought about from youth to maturity may more or less fully counteract the tendency of increase in river load to cause aggradation. But, on the other hand, as soon as the uplands begin to lose height, the rainfall must decrease; for it is well known that the obstruction to wind-movement caused by highlands is an effective cause of precipitation. While it is a gross exaggeration to maintain that the quaternary Alpine glaciers caused their own destruction by reducing the height of the mountains on which their snows were gathered, it is perfectly logical to deduce a decrease of precipitation as an accompaniment of loss of height from the youth to the old age of a land-mass. Thus many factors must be considered before the life-history of a river can be fully analyzed.

The growth of subsequent streams and drainage areas must be at the expense of the original consequent streams and consequent drainage areas. All changes of this kind are promoted by the occurrence of inclined instead of horizontal rock-layers, and hence are of common occurrence in mountainous regions, but rare in strictly horizontal plains. The changes are also favoured by the occurrence of strong contrasts in the resistance

of adjacent strata. In consequence of the migration of divides thus caused, many streams come to follow valleys that are worn down along belts of weak strata, while the divides come to occupy the ridges that stand up along the belts of stronger strata; in other words, the simple consequent drainage of youth is modified by the development of subsequent drainage lines, so as to bring about an *increasing adjustment of streams to structures*, than which nothing is more characteristic of the mature stage of the geographical cycle. Not only so: adjustments of this kind form one of the strongest, even if one of the latest, proofs of the erosion of valleys by the streams that occupy them, and of the long continued action in the past of the slow processes of weathering and washing that are in operation to-day.

There is nothing more significant of the advance in geographical development than the changes thus brought about. The processes here involved are too complicated to be now presented in detail, but they may be briefly illustrated by taking the drainage of a denuded arch, suggested

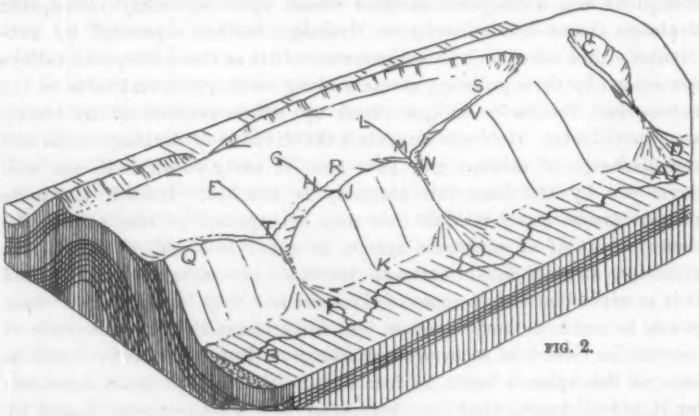

FIG. 2.

by the Jura mountains, as a type example. AB, Fig. 2, is a main longitudinal consequent stream following a trough whose floor has been somewhat aggraded by the waste actively supplied by the lateral consequents, CD, LO, EF, etc. At an earlier stage of denudation, before the hard outer layer was worn away from the crown of the mountain arch, all the lateral consequents headed at the line of the mountain crest. But, guided by a weak under-stratum, subsequent streams, TR, MS, have been developed as the branches of certain lateral consequents, EF, LO, and thus the hard outer layer has been undermined and partly removed, and many small lateral consequents have been beheaded. To-day, many of the laterals, like JK, have their source on the crest of the lateral ridge VJQ, and the headwaters, such as GH, that once belonged to them, are now diverted by the subsequent streams to swell the volume of the more

successful laterals, like EF. Similar changes having taken place on the further slope of the mountain arch, we now find the original consequent divide of the arch-crest supplemented by the subsequent divides formed by the lateral ridges. A number of short streams, like JH, belonging to a class not mentioned above, run down the inner face of the lateral ridges to a subsequent stream, RT. These short streams have a direction opposite to that of the original consequents, and may therefore be called obsequents. As denudation progresses, the edge of the lateral ridge will be worn further from the arch-crest; in other words, the subsequent divide will migrate towards the main valley, and thus a greater length will be gained by the diverted consequent headwaters, GH, and a greater volume by the subsequents, SM and RT. During these changes the inequality that must naturally prevail between adjacent successful consequents, EF and LO, will eventually allow the subsequent branch, RT, of the larger consequent, EF, to capture the headwaters, LM and SM, of the smaller consequent, LO. In late maturity the headwaters of so many lateral consequents may be diverted to swell the volume of EF, that the main longitudinal consequent above the point F may be reduced to relatively small volume.

The Development of River Meanders.—It has been thus far implied that rivers cut their channels vertically downward, but this is far from being the whole truth. Every turn in the course of a young consequent stream causes the stronger currents to press toward the outer bank, and each irregular, or, perhaps, subangular bend is thus rounded out to a comparatively smooth curve. The river therefore tends to depart from its irregular initial path (background block of Fig. 3) towards a serpentine course, in which it swings to right and left over a broader belt than at first. As the river cuts downwards and outwards at the same time, the valley-slopes become unsymmetrical (middle block of Fig. 3), being steeper on the side toward which the current is urged by centrifugal force. The steeper valley side thus gains the form of a half-amphitheatre, into which the gentler sloping side enters as a spur of the opposite uplands. When the graded condition is attained by the stream, downward cutting practically ceases, but outward cutting continues; a normal flood-plain is then formed as the channel is withdrawn from the gently sloping side of the valley (foreground block of Fig. 3). Flood-plains of this kind are easily distinguished in their early stages from those already mentioned (formed by aggrading the flat courses of incompetent young rivers, or by aggrading the graded valleys of overloaded rivers in early maturity); for these occur in detached lunate areas, first on one side, then on the other side of the stream, and always systematically placed at the foot of the gentler sloping spurs. But, as time passes, the river impinges on the up-stream side, and withdraws from the down-stream side of every spur, and thus the spurs are gradually consumed; they are first sharpened, so as better to observe

their name; they are next reduced to short cusps; then they are worn back to blunt salients; and finally, they are entirely consumed, and the river wanders freely on its open flood-plain, occasionally swinging against the valley side, now here, now there. By this time the curves of youth are changed into systematic meanders, of radius appropriate to river volume; and, for all the rest of an undisturbed life, the river persists in the habit of serpentine flow. The less the slope of the flood-plain becomes in advancing old age, the larger the arc of each meander,

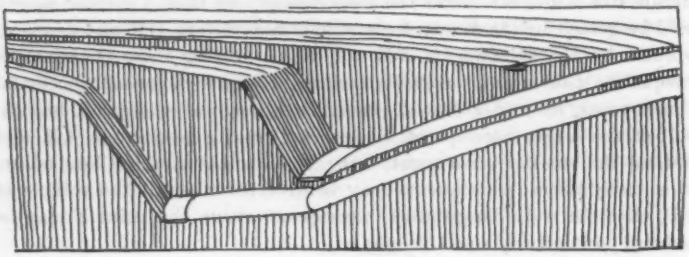

FIG. 3.

and hence the longer the course of the river from any point to its mouth. Increase of length from this cause must tend to diminish fall, and thus to render the river less competent than it was before; and the result of this tendency will be to retard the already slow process by which a gently sloping flood-plain is degraded so as to approach coincidence with a level surface; but it is not likely that old rivers often remain undisturbed long enough for the full realization of these theoretical conditions.

The migration of divides must now and then result in a sudden increase in the volume of one river and in a correspondingly sudden decrease of another. After such changes, accommodation to the changed volume must be made in the meanders of each river affected. The one that is increased will call for enlarged dimensions; it will usually adopt a gentler slope, thus terracing its flood-plain, and demand a greater freedom of swinging, thus widening its valley. The one that is decreased will have to be satisfied with smaller dimensions; it will wander aimlessly in relatively minute meanders on its flood-plain, and from increase of length, as well as from loss of volume, it will become incompetent to transport the load brought in by the side streams, and thus its flood-plain must be aggraded. There are beautiful examples known of both these peculiar conditions.

THE DEVELOPMENT OF GRADED VALLEY SIDES.—When the migration of divides ceases in late maturity, and the valley floors of the adjusted

streams are well graded, even far toward the headwaters, there is still to be completed another and perhaps even more remarkable sequence of systematic changes than any yet described: this is the development of graded waste slopes on the valley sides. It is briefly stated that valleys are eroded by their rivers; yet there is a vast amount of work performed in the erosion of valleys in which rivers have no part. It is true that rivers deepen the valleys in the youth, and widen the valley floors during the maturity and old age of a cycle, and that they carry to the sea the waste denuded from the land; it is this work of transportation to the sea that is peculiarly the function of rivers; but the material to be transported is supplied chiefly by the action of the weather on the steeper consequent slopes and on the valley sides. The transportation of the weathered material from its source to the stream in the valley bottom is the work of various slow-acting processes, such as the surface wash of rain, the action of ground water, changes of temperature, freezing and thawing, chemical disintegration and hydration, the growth of plant-roots, the activities of burrowing animals. All these cause the weathered rock waste to wash and creep slowly downhill, and in the motion thus ensuing there is much that is analogous to the flow of a river. Indeed, when considered in a very broad and general way, a river is seen to be a moving mixture of water and waste in variable proportions, but mostly water; while a creeping sheet of hillside waste is a moving mixture of waste and water in variable proportions, but mostly waste. Although the river and the hillside waste-sheet do not resemble each other at first sight, they are only the extreme members of a continuous series; and when this generalization is appreciated, one may fairly extend the "river" all over its basin, and up to its very divides. Ordinarily treated, the river is like the veins of a leaf; broadly viewed, it is like the entire leaf. The verity of this comparison may be more fully accepted when the analogy, indeed, the homology, of waste-sheets and water-streams is set forth.

In the first place, a waste-sheet moves fastest at the surface and slowest at the bottom, like a water-stream. A graded waste-sheet may be defined in the very terms applicable to a graded water-stream; it is one in which the ability of the transporting forces to do work is equal to the work that they have to do. This is the condition that obtains on those evenly slanting, waste-covered mountain-sides which have been reduced to a slope that engineers call "the angle of repose," because of the apparently stationary condition of the creeping waste, but that should be called, from the physiographic standpoint, "the angle of first-developed grade." The rocky cliffs and ledges that often surmount graded slopes are not yet graded; waste is removed from them faster than it is supplied by local weathering and by creeping from still higher slopes, and hence the cliffs and ledges are left almost bare;

they correspond to falls and rapids in water-streams, where the current is so rapid that its cross-section is much reduced. A hollow on an initial slope will be filled to the angle of grade by waste from above; the waste will accumulate until it reaches the lowest point on the rim of the hollow, and then outflow of waste will balance inflow; and here is the evident homologue of a lake.

In the second place, it will be understood, from what has already been said, that rivers normally grade their valleys retrogressively from the mouth headwards, and that small side streams may not be graded till long after the trunk river is graded. So with waste-sheets; they normally begin to establish a graded condition at their base, and then extend it up the slope of the valley side whose waste they "drain." When rock-masses of various resistance are exposed on the valley side, each one of the weaker is graded with reference to the stronger one next downhill; and the less resistant of the stronger ones are graded with reference to the more resistant (or with reference to the base of the hill): this is perfectly comparable to the development of graded stretches and to the extinction of falls and rapids in rivers. Ledges remain ungraded on ridge-crests and on the convex front of hill spurs long after the graded condition is reached in the channels of wet-weather streams in the ravines between the spurs; this corresponds nicely with the slower attainment of grade in small side streams than in large trunk rivers. But as late maturity passes into old age, even the ledges on ridge-crests and spur-fronts disappear, all being concealed in a universal sheet of slowly creeping waste. From any point on such a surface a graded slope leads the waste down to the streams. At any point the agencies of removal are just able to cope with the waste that is there weathered *plus* that which comes from further uphill. This wonderful condition is reached in certain well-denuded mountains, now subdued from their mature vigour to the rounded profiles of incipient old age. When the full meaning of their graded form is apprehended, it constitutes one of the strongest possible arguments for the sculpture of the lands by the slow processes of weathering, long continued. To look upon a landscape of this kind without any recognition of the labour expended in producing it, or of the extraordinary adjustments of streams to structures, and of waste to weather, is like visiting Rome in the ignorant belief that the Romans of to-day have had no ancestors.

Just as graded rivers slowly degrade their courses after the period of maximum load is past, so graded waste-sheets adopt gentler and gentler slopes when the upper ledges are consumed and coarse waste is no longer plentifully shed to the valley sides below. A changing adjustment of a most delicate kind is here discovered. When the graded slopes are first developed, they are steep, and the waste that covers them is coarse and of moderate thickness; here the strong agencies of removal have all they can do to dispose of the plentiful supply of coarse waste

from the strong ledges above, and the no less plentiful supply of waste that is weathered from the weaker rocks beneath the thin cover of detritus. In a more advanced stage of the cycle, the graded slopes are moderate, and the waste that covers them is of finer texture and greater depth than before; here the weakened agencies of removal are favoured by the slower weathering of the rocks beneath the thickened waste cover, and by the greater refinement (reduction to finer texture) of the loose waste during its slow journey. In old age, when all the slopes are very gentle, the agencies of waste-removal must everywhere be weak, and their equality with the processes of waste-supply can be maintained only by the reduction of the latter to very low values. The waste-sheet then assumes a great thickness—even 50 or 100 feet—so that the progress of weathering is almost *nil;* at the same time, the surface waste is reduced to extremely fine texture, so that some of its particles may be moved even on faint slopes. Hence the occurrence of deep soils is an essential feature of old age, just as the occurrence of bare ledges is of youth. The relationships here obtaining are as significant as those which led Playfair to his famous statement concerning the origin of valleys by the rivers that drain them.

Old Age.—Maturity is past and old age is fully entered upon when the hilltops and the hillsides, as well as the valley floors, are graded. No new features are now developed, and those that have been earlier developed are weakened or even lost. The search for weak structures and the establishment of valleys along them has already been thoroughly carried out; now the larger streams meander freely in open valleys and begin to wander away from the adjustments of maturity. The active streams of the time of greatest relief now lose their headmost branches, for the rainfall is lessened by the destruction of the highlands, and the run-off of the rain water is retarded by the flat slopes and deep soils. The landscape is slowly tamed from its earlier strength, and presents only a succession of gently rolling swells alternating with shallow valleys, a surface everywhere open to occupation. As time passes, the relief becomes less and less; whatever the uplifts of youth, whatever the disorder and hardness of the rocks, an almost featureless plain (a peneplain) showing little sympathy with structure, and controlled only by a close approach to baselevel, must characterize the penultimate stage of the uninterrupted cycle; and the ultimate stage would be a plain without relief.

Some observers have doubted whether even the penultimate stage of a cycle is ever reached, so frequently do movements in the Earth's crust cause changes in its position with respect to baselevel. But, on the other hand, there are certain regions of greatly disordered structure, whose small relief and deep soils cannot be explained without supposing them to have, in effect, passed through all the stages above described—and doubtless many more, if the whole truth were told—before reaching the

penultimate, whose features they verify. In spite of the great disturbances that such regions have suffered in past geological periods, they have afterwards stood still so long, so patiently, as to be worn down to pene-plains over large areas, only here and there showing residual reliefs where the most resistant rocks still stand up above the general level. Thus verification is found for the penultimate as well as for many earlier stages of the ideal cycle. Indeed, although the scheme of the cycle is here presented only in theoretical form, the progress of developmental changes through the cycle has been tested over and over again for many structures and for various stages; and on recognizing the numerous accordances that are discovered when the consequences of theory are confronted with the facts of observation, one must feel a growing belief in the verity and value of the theory that leads to results so satisfactory.

It is necessary to repeat what has already been said as to the practical application of the principles of the geographical cycle. Its value to the geographer is not simply in giving explanation to land-forms; its greater value is in enabling him to see what he looks at, and to say what he sees. His standards of comparison, by which the unknown are likened to the known, are greatly increased over the short list included in the terminology of his school-days. Significant features are consciously sought for; exploration becomes more systematic and less haphazard. "A hilly region" of the unprepared traveller becomes (if such it really be) "a maturely dissected upland" in the language of the better prepared traveller; and the reader of travels at home gains greatly by the change. "A hilly region" brings no definite picture before the mental eyes. "A maturely dissected upland" suggests a systematic association of well-defined features; all the streams at grade, except the small headwaters; the larger rivers already meandering on flood-plained valley floors; the upper branches ramifying among spurs and hills, whose flanks show a good beginning of graded slopes; the most resistant rocks still cropping out in ungraded ledges, whose arrangement suggests the structure of the region. The practical value of this kind of theoretical study seems to me so great that, among various lines of work that may be encouraged by the Councils of the great Geographical Societies, I believe there is none that would bring larger reward than the encouragement of some such method as is here outlined for the systematic investigation of land-forms.

Some geographers urge that it is dangerous to use the theoretical or explanatory terminology involved in the practical application of the principles of the geographical cycle; mistakes may be made, and harm would thus be done. There are various sufficient answers to this objection. A very practical answer is that suggested by Penck, to the effect that a threefold terminology should be devised—one set of terms being purely empirical, as "high," "low," "cliff," "gorge," "lake," "island;" another set being based on structural relations, as "monoclinal ridge,"

"transverse valley," "lava-capped mesa;" and the third being reserved for explanatory relations, as "mature dissection," "adjusted drainage," "graded slopes." Another answer is that the explanatory terminology is not really a novelty, but only an attempt to give a complete and systematic expansion to a rather timid beginning already made; a sand-dune is not simply a hillock of sand, but a hillock heaped by the wind; a delta is not simply a plain at a river mouth, but a plain formed by river action; a volcano is not simply a mountain of somewhat conical form, but a mountain formed by eruption. It is chiefly a matter of experience and temperament where a geographer ceases to apply terms of this kind. But little more than half a century ago, the erosion of valleys by rivers was either doubted or not thought of by the practical geographer; to-day, the mature adjustment of rivers to structures is in the same position; and here is the third, and to my mind the most important, answer to those conservatives who would maintain an empirical position for geography, instead of pressing forward toward the rational and explanatory geography of the future. It cannot be doubted, in view of what has already been learned to-day, that an essentially explanatory treatment must in the next century be generally adopted in all branches of geographical study; it is full time that an energetic beginning should be made towards so desirable an end.

Interruptions of the Ideal Cycle.—One of the first objections that might be raised against a terminology based on the sequence of changes through the ideal uninterrupted cycle, is that such a terminology can have little practical application on an Earth whose crust has the habit of rising and sinking frequently during the passage of geological time. To this it may be answered, that if the scheme of the geographical cycle were so rigid as to be incapable of accommodating itself to the actual condition of the Earth's crust, it would certainly have to be abandoned as a theoretical abstraction; but such is by no means the case. Having traced the normal sequence of events through an ideal cycle, our next duty is to consider the effects of any and all kinds of movements of the land-mass with respect to its baselevel. Such movements must be imagined as small or great, simple or complex, rare or frequent, gradual or rapid, early or late. Whatever their character, they will be called "interruptions," because they determine a more or less complete break in processes previously in operation, by beginning a new series of processes with respect to the new baselevel. Whenever interruptions occur, the pre-existent conditions that they interrupt can be understood only after having analyzed them in accordance with the principles of the cycle, and herein lies one of the most practical applications of what at first seems remotely theoretical. A land-mass, uplifted to a greater altitude than it had before, is at once more intensely attacked by the denuding processes in the new cycle thus initiated; but the forms on which the new attack is made can only be understood by

considering what had been accomplished in the preceding cycle previous to its interruption. It will be possible here to consider only one or two specific examples from among the multitude of interruptions that may be imagined.

Let it be supposed that a maturely dissected land-mass is evenly uplifted 500 feet above its former position. All the graded streams are hereby revived to new activities, and proceed to entrench their valley floors in order to develop graded courses with respect to the new baselevel. The larger streams first show the effect of the change; the smaller streams follow suit as rapidly as possible. Falls reappear for a time in the river-channels, and then are again worn away. Adjustments of streams to structures are carried further in the second effort of the new cycle than was possible in the single effort of the previous cycle. Graded hillsides are undercut; the waste washes and creeps down from them, leaving a long even slope of bare rock; the rocky slope is hacked into an uneven face by the weather, until at last a new graded slope is developed. Cliffs that had been extinguished on graded hillsides in the previous cycle are thus for a time brought to life again, like the falls in the rivers, only to disappear in the late maturity of the new cycle.

The combination of topographic features belonging to two cycles may be called "composite topography," and many examples could be cited in illustration of this interesting association. In every case, description is made concise and effective by employing a terminology derived from the scheme of the cycle. For example, Normandy is an uplifted peneplain, hardly yet in the mature stage of its new cycle; thus stated, explanation is concisely given to the meandering course of the rather narrow valley of the Seine, for this river has carried forward into the early stages of the new cycle the habit of swinging in strong meanders that it had learned in the later stages of the former cycle.

If the uplift of a dissected region be accompanied by a gentle tilting, then all the water-streams and waste-streams whose slope is increased will be revived to new activity; while all those whose slope is decreased will become less active. The divides will migrate into the basins of the less active streams, and the revived streams will gain length and drainage area. If the uplift be in the form of an arch, some of the weaker streams whose course is across the axis of the arch may be, as it were, "broken in half;" a reversed direction of flow may be thus given to one part of the broken stream; but the stronger rivers may still persevere across the rising arch in spite of its uplift, cutting down their channels fast enough to maintain their direction of flow unchanged; and such rivers are known as "antecedent."

The changes introduced by an interruption involving depression are easily deduced. Among their most interesting features is the invasion of the lower valley floors by the sea, thus "drowning" the valleys to a

certain depth, and converting them into bays. Movements that tend to produce trough-like depressions across the course of a river usually give birth to a lake of water or waste in the depressed part of the river valley. In mountain ranges frequent and various interruptions occur during the long period of deformation; the Alps show so many recent interruptions that a student there would find little use for the ideal cycle; but in mountain regions of ancient deformation, the disturbing forces seem to have become almost extinct, and there the ideal cycle is almost realized. Central France gives good illustration of this principle. It is manifest that one might imagine an endless number of possible combinations among the several factors of structure, stage of development at time of interruption, character of interruption, and time since interruption; but space cannot be here given to their further consideration.

Accidental Departures from the Ideal Cycle.—Besides the interruptions that involve movements of a land-mass with respect to baselevel, there are two other classes of departure from the normal or ideal cycle that do not necessarily involve any such movements: these are changes of climate and volcanic eruptions, both of which occur so arbitrarily as to place and time that they may be called "accidents." Changes of climate may vary from the normal towards the frigid or the arid, each change causing significant departures from normal geographical development. If a reverse change of climate brings back more normal conditions, the effects of the abnormal "accident" may last for some small part of a cycle's duration before they are obliterated. It is here that features of glacial origin belong, so common in north-western Europe and north-eastern America. Judging by the present analysis of glacial and interglacial epochs during quaternary time, or of humid and arid epochs in the Great Salt Lake region, it must be concluded that accidental changes may occur over and over again within a single cycle.

In brief illustration of the combined interruptions and accidents, it may be said that southern New England is an old mountain region, which had been reduced to a pretty good peneplain when further denudation was interrupted by a slanting uplift, with gentle descent to the south-east; that in the cycle thus introduced the tilted peneplain was denuded to a sub-mature or late mature stage (according to the strength or weakness of its rocks); and that the maturely dissected region was then glaciated and slightly depressed so recently that little change has happened since. An instructive picture of the region may be conceived from this brief description.

Many volcanic eruptions produce forms so large that they deserve to be treated as new structural regions; but when viewed in a more general way, a great number of eruptions, if not the greater number, produce forms of small dimensions compared to those of the structures on which

they are superposed: the volcanoes of central France are good instances of this relation. Thus considered, volcanoes and lava-flows are so arbitrarily placed in time and space that their classification under the head of "accidents" is warranted. Still further ground for this classification is found when the effects of a volcanic eruption on the pre-existent processes of land-sculpture are examined. A valley may be blockaded by a growing cone and its lava-flows; lakes may form in the up-stream portion of such a valley, even if it be mature or old. If the blockade be low, the lake will overflow to one side of the barrier, and thus the river will be locally displaced from its former course, however well adjusted to a weak structure that course may have been. If the blockade be higher than some points on the headwater divides, the lake will overflow "backwards," and the upper part of the river system will become tributary to an adjacent system. The river must cut a gorge across the divide, however hard the rocks are there; thus systematic adjustments to structure are seriously interfered with, and accidental relations are introduced. The form of the volcanic cone and the sprawling flow of its lava-streams are quite out of accord with the forms that characterize the surrounding region. The cone arbitrarily forms a mountain, even though the subjacent rocks may be weak; the lava-flows aggrade valleys that should be degraded. During the dissection of the cone, a process that is systematic enough if considered for itself alone, a radial arrangement of spurs and ravines will be developed; in long future time the streams of such ravines may cut down through the volcanic structures, and thus superpose themselves most curiously on the underlying structures. The lava-flows, being usually more resistant than the rocks of the district that they invade, gain a local relief as the adjoining surface is lowered by denudation; thus an inversion of topography is brought about, and a "table-mountain" comes to stand where formerly there had been the valley that guided the original course of the lava-flow. The table-mountain may be quite isolated from its volcanic source, where the cone is by this time reduced to a knob or "butte." But although these various considerations seem to me to warrant the classification of volcanic forms as "accidental," in contrast to the systematic forms with which they are usually associated, great importance should not be attached to this method of arrangement; it should be given up as soon as a more truthful or more convenient classification is introduced.

THE FORMS ASSUMED BY LAND WASTE.—An extension of the subject treated in the section on Graded Valley Sides, would lead to a general discussion of the forms assumed by the waste of the land on the way to the sea; one of the most interesting and profitable topics for investigation that has come under my notice. Geographers are well accustomed to giving due consideration to the forms assumed by the water-drainage of the land on the way to the sea, and a good terminology is already in

use for naming them; but much less consideration is given to the forms assumed by the waste that slowly moves from the land to the sea. They are seldom presented in their true relations; many of them have no generally accepted names—for example, the long slopes of waste that reach forward from the mountains into the desert basins of Persia; forms as common as alluvial fans are unmentioned in all but the most recent school-books; and such features as till plains, moraines, and drumlins are usually given over to the geologist, as if the geographer had nothing to do with them! There can be no question of the great importance of waste-forms to the geographer, but it is not possible here to enter into their consideration. Suffice it to say that waste-forms constitute a geographical group which, like water-forms, stand quite apart from such groups as mountains and plateaus. The latter are forms of structure, and should be classified according to the arrangement of their rocks, and to their age or stage of development. The former are forms of process, and should be classified according to the processes involved, and to the stage that they have reached. The application of this general principle gives much assistance in the description of actual landscapes.

Lack of space prevents due consideration here of the development of shore-lines, a subject not less interesting, suggestive, and helpful than the development of inland forms; but I shall hope to return on some later occasion to a discussion of shore features, when it may be found that much of the terminology already introduced is again applicable. In closing this article, I must revert, if even for a third time, to the practical side of the theoretical cycle, with its interruptions and accidents. It cannot be too carefully borne in mind that the explanation of the origin of land-forms is not for its own sake added to the study of geography, but for the sake of the aid that explanation gives to the observation and description of existing geographical features. The sequence of forms developed through the cycle is not an abstraction that one leaves at home when he goes abroad; it is literally a *vade-mecum* of the most serviceable kind. During the current year that I am spending in Europe, the scheme and the terminology of the cycle have been of the greatest assistance in my studies. Application of both scheme and terminology is found equally well in the minute and infantile coastal plains that border certain stretches of the Scotch shore-line in consequence of the slight post-glacial elevation of the land, and in the broad and aged central plateau of France, where the young valleys of to-day result from the uplift of the region, and the revival of its rivers after they had submaturely dissected a pre-existent peneplain. The adjustments of streams to structures brought about by the interaction of the waxing Severn and the waning Thames, prove to be even more striking than when I first noticed them in 1894.* The large ancient delta of the Var, between

* See *Geographical Journal*, 1895; and *Proceedings Geologists' Association*, 1899.

Nice and Cannes, now uplifted more than 200 metres, and maturely dissected, must come to be the type example of this class of forms. The Italian Riviera, west of Genoa, may be concisely described as a region of subdued mountains that has been partly submerged and that is now approaching maturity of shore-line features in the cycle thus initiated: one may picture, from this brief statement, the mountain spurs with well-graded slopes, limited by a very irregular shore-line when first depressed, but now fronting in a comparatively simple shore-line of cliffed headlands and filled bays. The peninsula of Sorrento, on its northern side, once resembled the Riviera, but it has now been elevated 50 metres, and its uplifted bay-plains have cliffed fronts. The lower Tiber, whose mature valley floor is now somewhat wider than its meander belt, is consequent upon a volcanic accident, for it follows the trough between the slopes of the Bracciano volcanic centre on the north-west, and the Alban centre on the south-east; further up-stream, as far as Orvieto, the river, as a rule, follows a trough between the Apennines and the three volcanic centres of Bolsena, Vico, and Bracciano. The Lepini mountains, a maturely carved block of moderately deformed Cretaceous limestones south of the Alban volcanic group, has along a part of its north-eastern base a very young fault cliff, by which the graded slopes of the spurs and ravines are abruptly cut off; the fault cliff is easily recognized from the train on the line between Rome and Naples.

Botanists and zoologists know very well that a trained observer can easily recognize and describe many small items of form that pass without notice from the untrained observer. It is the same in geography, and the only question is—How can the desired training be secured? Of the many methods of geographical training, I believe that, as far as the forms of the land are concerned, no method can equal the value of one in which explanation is made an essential feature along with observation, for there is no other in which so many mental faculties are exercised.

CONTRIBUTIONS TO THE GEOGRAPHY OF LAKE URMI AND ITS NEIGHBOURHOOD.*

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THE following notes are the result of travels in the plateau of Azerbaijan during the summer months of 1898, for the purpose of investigating the fauna and flora of the salt lake of Urmi and of its fresh-water tributaries.

The map of the lake is an attempt to lessen some of the errors of other maps. It is a compromise between my own observations and the best maps to which I have had access. I should like to draw especial attention to the inaccuracies and unsatisfactory discrepancies of all published maps of the district, and to the importance of a more

* Map, p. 592.

accurate survey of the lake and its islands. When the limits of the lake, both in its season of high and of low water, have been mapped with precision, the physical geographer will be in a better position to realize and to explain the extraordinary changes of level which the lake, like so many other salt lakes, has exhibited in recent years. He will then be enabled to state with more confidence, than at present, whether the recent flooding of the western littoral is due to a movement of the crust of the Earth, more gradual than those which destroyed Tabriz, or merely to an increase of rainfall as compared with evaporation.

I am glad to take this opportunity of acknowledging my indebtedness to the Government Grant Committee of the Royal Society for pecuniary assistance, as well as to the Royal Geographical Society for the loan of instruments. I am also under deep personal obligations to the members of the Archbishop of Canterbury's Assyrian Mission and to H.M. Consul-General, Mr. Cecil Wood, for their unfailing courtesy and hospitality at Urmi and at Tabriz. For my personal safety and for the loan of one of the ships on the lake, I am greatly indebted to the Amir Nizam.

The name Urmi, or Urmia, appears under a variety of synonyms in maps and literature. Urmi is the form adopted by the Archbishop's Mission and by Kiepert, and is the local name for the town. The variations Urumia, Urumea, Urumiyeh, Ooroomieyah, Urumiyah have their origin in foreign mispronunciations or in false etymological derivations, and never seem to have been indigenous. In Persia, except from the lips of certain members of the American Mission, I never heard any other pronunciation than Urmi. The lake is known as the Urmi-gjölü on the western side, but Shah-gjölü in Tabriz (Kiepert), and appears to be the Σπαύτα of Strabo.

Hydrography.—The Urmi lake-basin is situated upon a plateau of over 4000 feet above sea-level, which is the water-parting between the rivers flowing into the Caspian sea and those flowing into the Persian gulf, or between the Arctic * and the Indian oceans. On this plateau is a depression which Sir Oliver St. John estimated as extending over an area of 20,000 square miles. I have redetermined it at 19,370 square miles, of which 1795 square miles are at present occupied by the Lake of Urmi and its islands.

The level of the lake is about 4100 feet (4025, Schindler) above sea-level; about 4184 feet, or 84 feet more, above the level of the Caspian; and about 1114 feet lower than Lake Van (5214 feet). Its depth is insignificant as compared with its area, and probably does not

* The Caspian sea is regarded as belonging to the Arctic water system. The fauna of the Caspian sea affords indications, zoologically very convincing, of a not very remote connection of its waters with those of the Arctic ocean.

exceed 50 feet. Over the water-partings the lowest passes vary from about 5700 feet to 9000 feet on the west, while several mountains rise to a height of over 10,000 feet (Savalan, 15,792; Sahend, 11,630). The Kurdish mountains to the west retain their winter's snow until after midsummer.

One of the most interesting of the phenomena exhibited by Lake Urmi is the hitherto unaccountable rise and fall of the level of its waters. Like so many desert lakes which have no overflow, and unlike lakes in temperate zones, the size of Lake Urmi is not only continually changing with the season of the year, but is also subject to fluctuations occurring in longer and less regular cycles, to the great annoyance of the dwellers on its littoral. An expedition of Italian investigators visited the lake during the winter of 1897,* and doubtless their report, when published, will show how insufficient the data of the local meteorology are for the elucidation of the problem.

The only continuous observations on the rainfall of the district to which I have had access were made as long ago as 1853–54, and are quoted by Supan in his excellent compilation of rainfall statistics published in the Ergänzungsheft, No. 124, of *Petermanns Mitteilungen* for 1898. The rainfall for that year was 547 millimetres, or about 22 inches, of which less than 40 millimetres fell during June, July, August, and September. It is highly improbable that that figure represents the average rainfall for the entire Urmi basin. That portion of the rain-water which falls upon the 19,370 square miles of the Urmi basin, and which finally finds its way into the lake, is really a small proportion of the entire rainfall, because a large proportion is lost by evaporation from the plains which surround the lake. The torrents from the mountains soon unite in common channels; but their waters are often redistributed among irrigation canals, and are thus dispersed over a wide expanse of fertile plain. Consequently, but little water reaches the lake when summer irrigation is in progress.

Rivers.—The river systems which discharge into Lake Urmi are naturally divisible into four groups.

To the first group belong the rivers which receive the drainage from the mountains to the west. The Zola Chai, or Salmas Chai, waters the plain of Salmas; the plain of Urmi is watered by the Nazlu, Shaher (or Nah ad medita), and Barenduz.

The several tributaries of the Nazlu Chai rise among the mountains of Tergawar within the Persian territory, and on reaching the plain of Urmi unite into a single stream which falls into the lake quite near Superghan. Like many of these mountain streams, the Nazlu Chai is occasionally liable to serious floods, owing to landslips blocking the river and damming up a head of water, which sooner or later bursts

* *Bollettino della Società Geographica Italiana*, x. pp. 459, 460. 1897.

through the obstruction with overwhelming violence. Such a catastrophe happened in May, 1896. Great tracts of the plain along the entire course of the river were flooded, huge trees were torn up, vineyards wrecked, and even entire villages were destroyed. The middle piers and arches of the very fine and substantial brick bridge of Chankaralui, on the road from Urmi to Gavilan, were carried off.

All of these rivers contain an abundance of chub, roach, and *Capoeta*, but none of them contain the *Silurus glanis*, which is found in the Gader Chai which, although entering the lake from the southern end, takes its

MAIN STREET, ARDISHAI.
(*From a photograph by E. H. Heazell, Esq.*)

source in the same range of mountains as the other members of the group. The entire area drained by these rivers is about 4313 square miles.

To the second and southern group belong the two large rivers, the Tatawa Chai with its Sujbulak tributary, and the Djaghatu Chai, which together drain an area of 6323 square miles. The mouths of these rivers are hard to define, since they change with the seasonal redistributions of land and water. What is dry, sun-cracked grassland with an abundance of sea-lavender and a yellow mullein (Bishop) in summer, becomes an impassable marsh after the winter. These rivers contain great quantities of *Silurus glanis*, which grow to the considerable length of 5 feet.

The third group includes the many small channels which seam the

sides of the trachytic Mount Sahend and the valley of the Adji Chai, which, rising in the Savalan, waters the valley in which Tabriz is situated. When much water is coming down the Adji Chai, and when the lake-level is high, the plain near the mouth of the Adji Chai becomes a swamp, and the Shahi becomes an island.

The fourth group drains the narrow strip of land to the north of the lake. There is only one stream of any considerable size, viz. the Salian Rud; the other drainage channels are insignificant.

The relative importance of these various streams, as shown by the approximate area drained by each, is set forth in the accompanying table—

TABLE OF AREAS DRAINED BY THE RIVERS FLOWING INTO LAKE URMI.

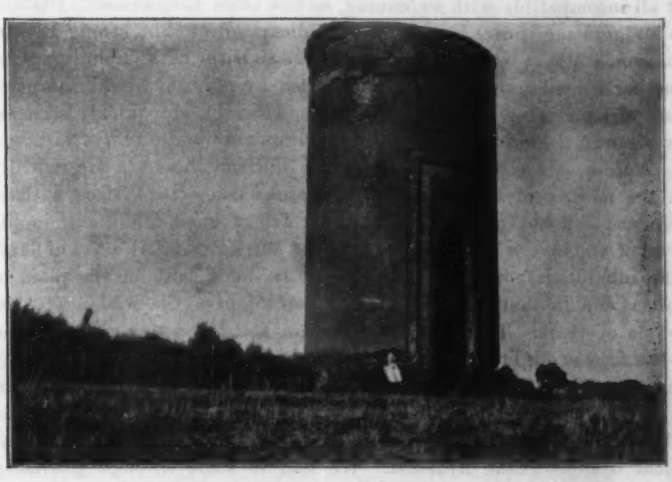
	Drainage areas, 100 sq. miles.
I.	
Zola Chai	11·7
Nazlu Chai	9·0
Shaher Chai	2·6
Barenduz Chai	5·4
Gader Chai	7·4
Other drainage areas	7·0
Total	43·1
II.	
Tatawa Chai	21·3
Djaghatu Chai	41·9
Total	63·2
III.	
Murdi Chai	4·1
Safi Chai	3·6
Slopes of Sahend	9·5
Adji Chai	38·9
Slopes of Shahi	2·8
Total	58·9
IV.	
Salian Rud	5·8
Other drainage areas	4·8
Total	10·6
SUMMARY.	
Area I.	43·1
„ II.	63·2
„ III.	58 9
„ IV.	10·6
„ of lake	17·9
Total area of Urmi basin ...	193 7

Springs.—In addition to the water of the rivers, Lake Urmi receives the water of many springs. St. George's spring below the hill at Superghan, the springs at Daschkiesen, and the spring on the island of Koyun Daghi, discharge their waters almost directly into the lake. Other springs are said to rise in the bed of the lake itself near Solduz, and have been accused by the natives of having caused the recent rise in the level of the water.

The Lake of Urmi itself extends over an area of about 1795 square miles at times of low water, and probably covers 600 square miles more in wet years when the spring thaws have melted the snow on the

plains. It measures about 80 miles from north to south, and 24 from east to west. It is a very shallow lake; the greatest depth does not exceed some 45 or 50 feet, and the average depth is far less, probably not more than 20 feet. Its shores for the most part are of a very gentle gradient; but at certain places, hills of Miocene limestone rock or of volcanic origin rise up abruptly from the usually flat shores. In the middle of the southern half of the lake is a group of islands, composed for the most part of Miocene calcareous rocks, but undoubted Palæozoic strata appear beneath them.

The analysis of the water of Lake Urmi * shows that it is about three-fifths as salt as the water of the Dead sea, and that it is still far from



SUNNITE TOWER, SALMAS.
(From a photograph by F. H. Heazell, Esq.)

being saturated. It is, however, far too salt to permit the existence of fish life, and therefore it must act as a very efficient barrier between otherwise disconnected fresh-water rivers, and be an absolute obstacle to migration. The only organisms at present living in the lake are a species of Artemia, a crustacean known from other brine lakes in Europe and North America, the larva of a species of dipterous insect, probably allied to Ephydra, and green vegetable masses composed of bacterial zoogloœæ covered with a species of diatom.

The temperature of the salt-lake waters remained tolerably constant during the month of August. The extremes recorded were 82° Fahr. on August 2, and 78·5° Fahr. on the 24th. On both occasions there was a stiffish breeze: from the south-west on the 2nd, when the air-temperature

* For details see *Proc. R. S.*, vol. 65, p. 312.

was 89° Fahr.; but from the south-east on the 24th, with an air-temperature of 80° Fahr. On August 23 and 25 the temperatures of the surface water were 80° and 79° Fahr. respectively at sunrise, while the bottom water (*circ.* 3 to 4 fathoms) was at a temperature of 77° Fahr. on both occasions. It would be most interesting to have the winter temperatures recorded as well.

The water has a very painful action on the mucous membranes of the eyes, nose, and mouth, but otherwise I did not experience any of the unpleasant effects which are usually attributed to such strongly saline waters.* I always found bathing pleasant on account of the great buoyancy of the water, and did not find that the buoyancy was at all incompatible with swimming, as has often been stated. Bathing is invigorating if care be taken to avoid exposure to the strong rays of the sun. A man with a sun-tanned back can bathe with impunity, when another whose spinal cord is unprotected by pigment would run great risk of sunstroke. On emerging, if the water be not quickly removed by a towel, the skin becomes covered with a thin white film of salt.

Margin of Lake.—The fertile plain of Urmi descends so gradually to the margin of the lake, and then sinks below its surface with so imperceptible an incline, that a rise or fall of but a few inches in the level of the lake is sufficient to flood or leave dry many acres of land. The inhabitants of the villages near the lake, both in the plain of Salmas and in that of Urmi, are complaining of a rise within the last couple of years. The water has risen in the *tanurus*, or underground ovens for baking bread, in some of the houses, and has submerged many acres of arable land. A rather unpleasant experience helped both Mr. Irving and myself to realize the present state of the margin of the lake. Contrary winds compelled us to land from our ship of about 4-foot draught near Ardishai. We had to wade through gradually shoaling water for about a mile. Although the land must have been submerged for some time, yet the ditches of former fields, and even their ridges and furrows, were painfully well preserved. As the water became shallower it also became hotter, and every footstep disengaged volumes of sulphuretted hydrogen from the stinking black mud. Nearer *terra firma* still, the shallow layer of water gave way to a brilliant white crust of crystalline salt covering the same sickening black mud, heated almost to scalding point by the sun. Although I spent many nights on or near the shores of the lake, I was never fortunate enough to witness the curious, and I should say extremely rare, phenomenon recorded by Dr. Wills at the north end of the lake near Turseh. On the evening of April 4, 18—, "many bituminous fires

* Cp. Strabo, bk. xi., 'Media:' "Lacum habet, qui Spauta dicitur in quo sales efflorescentes coguntur; ii pruritum doloresque excitant; oleum malo ei medetur, et aqua dulcis sanat sic inflammatas vestes, si quis ignarus lavandi causa eo immerserit" (Th. Falconer's translation, 1807).

lighted it up at night, huge sheets of flame suddenly appearing." None of my questions on the spot elicited any information on the subject. There is no doubt that the chemical changes which take place in the objectionable black mud are responsible for the formation of large quantities of sulphuretted hydrogen and probably also of marsh-gas, but whether they have any part in what seems to be a will-o'-the-wisp phenomenon on a gigantic scale is not proven. I never heard of any petroleum springs near Lake Urmi.

The flatness of the shore of the plain of Urmi is interrupted at two points. At about 2 miles south-east of Superghan a conical hill (St. George's hill) rises up suddenly on the margin of the lake, and at its foot, within a few yards of the lake, are several fresh-water springs, of which the largest is also called after St. George, the patron saint of Superghan, and is much in repute in cases of leprosy. On July 22 the temperature of its waters was 67° Fahr., while that of the lake-water was 80° Fahr.

The road from Urmi to Superghan passes by another isolated hill called Bakchikala, which is chiefly interesting on account of the tradition which associates its ruins with the native city of Zoroaster. The road is carried across some marshy ground by a causeway which leads towards the lake.

Further south the dead level of the shore is again broken by the picturesque Bezau Daghi (= Cow mountains), which are, at all events, partly volcanic (Appendix, 1, *a–d*), but which Loftus described as blue schist and ironstone. The highest

PANORAMIC VIEW OF PLAIN OF URMI.
(*From photographs taken by Atkinson Riley, Esq.*)

of its three chief peaks must be at least 800 feet above the little port of Gulmachana, where the quickly shelving beach and tufa rocks allow the boats to moor close inshore.

The fleet at present on Lake Urmi consists of three ships of about 20 tons burden, round bottomed, round bowed, but with flat sterns and a great capability of rolling. An enormous square sail, strengthened by diagonal horsehair tapes, is hung symmetrically from a yard on the mast stepped far forward. Each ship has a huge iron anchor at its bows, which plays an important part in the navigation. The ships can only sail before the wind, and consequently, when the wind shifts into an unfavourable quarter, which happens once or twice every day, the anchor is dropped until the wind becomes favourable once more.

We had a crew of seven Mussulmans, who told me that they and all those "who understand the art of walking upon the waters" come from the same village—Giamitshi, on the shores of the lake not far north of Ardishai. The sole right of navigation is vested in the Admiral of the Fleet, the Shahzada, governor of Maragha. The ship placed at my disposal by the agent, by command of the Amir Nizam, was called the *Nahangk* (= leopard). It was completely decked over, and smelt of sheep.

Islands.—In the southern half of the lake is a small group of rocky islands of ill-defined geographical position, but undoubtedly situated nearer the eastern than the western shore of the lake, and not *vice versâ* (Russian map). Some eight or nine of the islands in this archipelago have received names, but there are many small islets and upstanding rocks which have not been mapped, and are a source of anxiety to the navigator. From a distance they present a rounded appearance, like the knolls on our chalk downs, but from a near point of view their precipitous cliffs and rugged hillsides testify to the erosive powers of the heavy salt waves in stormy weather. Here and there are beaches of true marine shells, coral fragments, and echinoderms, such as could only have lived in a real sea of marine salinity and in connection with the ocean. These marine shells, now for a second time rolled by salt waves, tell the tale of a Miocene sea of normal salinity, which has been stated to have been a northerly continuation of the Persian gulf from the Indian ocean, but was almost certainly a part of the vast Miocene Mediterranean. This Miocene sea seems to have had a climate like that of the present Red sea, and, like it, was a coral sea. Upon its floor were laid down the chalk and limestone formations of the Urmi archipelago, as well as those of the calcareous mountains on the south of the lake, and which, so far as their fossils go, are very like the Miocene of the Vienna basin.

There is a tradition that the islands were connected with the mainland some eighty years ago by dry land, and that they were then inhabited. The captain of one of the ships assured me that there was

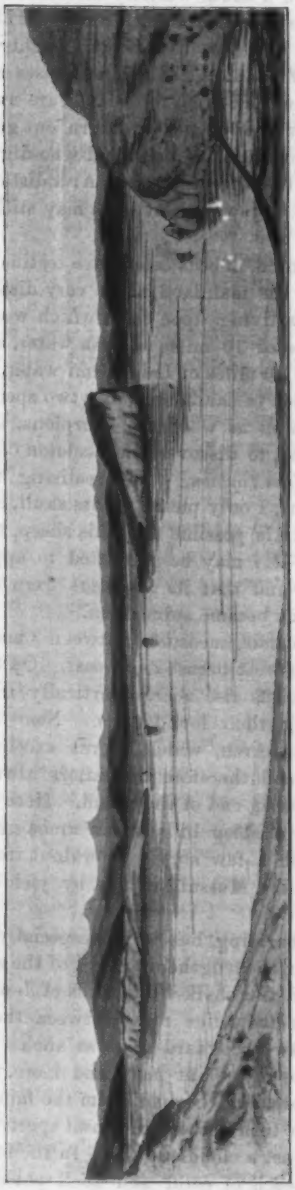
a submerged ridge of land extending in a south-westerly direction from the islands, but I had not time to make any soundings myself in verification of his statement. It is certain, however, that Koyun Daghi was formerly inhabited, because ruins and foundations of several houses may be traced near the spring. At the present time the islands are uninhabited, but they are often visited by the sailors, who turn out goats and sheep to pasture during certain months in the year, and who dig up for fuel the roots of trees cut down by their predecessors. At a distance from the landing-places of the sailors, a few walnut trees may still be found on Koyun Daghi.

The zoology of the islands, to my mind, affords conclusive testimony of their having been connected with the mainland at no very distant date. I found many species of animals living upon them which would have been very unlikely to have crossed 10 miles of fresh water, and which certainly could not have crossed 10 miles of Lake Urmi water.

On Koyun Daghi at least five species of land shells and two species of lizards (*Eremia* and *Eumeces*), as well as wood-lice, scorpions, and wingless insects. I was fortunate, also, to discover the skeleton of an undoubtedly wild sheep allied to *Ovis ophion*. Not realizing the importance of the discovery at the time, I only picked up its skull, and left the rest of the skeleton behind. It is possible that this sheep, too, may belong to a "Relikten-fauna"—if I may be permitted to apply Credner's name to a terrestrial fauna—and that its ancestors were cut off from the mainland when the isthmus became submerged.

Koyun Daghi, the largest of the islands, measures between 3 and 4 miles from end to end, from west-north-west to east-south-east. On the north-east its magnificent calcareous cliffs rise nearly vertically from the waters, which are slowly mining their foundations. Near the northern end is a small bay opposite Arzu, which affords excellent shelter, but there is no water near, and therefore the sailors always endeavour to make the cove at the other end of the island. Here we pitched our tent in an amphitheatre of steep hills on an arena overgrown with Artemisia bushes and with a few surviving walnut trees, which pay for their immunity from the Mussulman axe by yielding shade to his midday slumbers.

The view eastwards was always charming, but it was especially so when, towards the end of the afternoon, the lengthening rays of the sun setting behind the spectator illumined the chalk-white cliffs of Jewitt Daghi and Kizil Kugur, and the two tooth-like rocks between them. The white islands seemed to float like two guard-ships at anchor on the still blue of the salt lake. As the rays slant more and more, the red stratified cliffs of the farther shore, and beyond them the fainter irregular Sahend mountains, exhibit in turn the entire sunset spectrum of yellows, reds, and rosy purples against a cloudless sky. In the foreground enframing all is the white beach of coral and shell pebbles,



VIEW OF LAKE URMI FROM SPRING ON KOYUN DAGHI.

flanked by the hills at the horns of the bay, dotted with dark-green artemisia bushes.

Near our encampment was a spring of excellent fresh water, clear and cool, from the limestone hills. Its flow had shrunk to about a quart per minute owing to the drought, but it is said never to fail entirely. The overflow from the spring runs into a tiny marsh, which preserves its verdure all through the summer, and affords a grateful rendezvous to the crowds of thirsty birds which congregate at certain hours of the day. At the southern end of the beach is a small natural lagoon or salt-pan, which has been separated from the lake by the upheaval of a bar of shingle of about 30 feet in width. The lake-water percolates through the bar and becomes concentrated by evaporation in the lagoon. The specific gravity of the water in the lake was 1·113, whereas that of the water in the lagoon was 1·20; a white crust of salt outlined the margin.

Arzu is one of the larger islands in the archipelago. Its cliff-girt rounded hills rise to about half the altitude of those of Koyun Daghi. Their vegetation was much the same as that of the other islands—burnt-up grass dotted over with dark-green artemisia bushes and a few stunted walnut trees. There is said to be no water on the island. A hill at the south-west end is connected

with the rest of the island by a narrow beach, which was submerged to a depth of 2 to 3 inches in August, 1898. I was informed that but a year previously it was possible to cross dryshod. We have, therefore, further evidence of the recent rise of level of the waters.

Shazalan Island and Shazalan Hills.—These form a small group of islets, situated to the north of Arzu, which do not appear to be satisfactorily shown in the maps. The largest, Shazalan island, is about 500 yards long and about half as wide. Its greatest elevation near the southern end cannot be much more than 50 feet above the level of the lake. It is grass-grown, and supports many small bushes of the "kharauan" plant (*Artemisia*), as well as pigeons and lizards.

The Shazalan hills are of similar character to the east of Shazalan island, but separated from it by a channel of about 4 fathoms in depth. The cliffs of all indicate marine erosion for a very considerable period.

Ispir lies off the west end of Koyun Daghi. Its lower limestone hills do not rise above about 300 feet, and were yellow with dried grass when I saw them. The island seems to be about 1 mile long. Abich maintains that the same two geological divisions as on Koyun, may be distinguished in its rocks.

Ishak lies to the south of Koyun Daghi. I was not able to visit it, but believe it to be low and smaller than is shown on the maps.

Kizil Kugur and Jewitt Daghi have already been mentioned. They seem to have been formerly connected by a ridge of rock which has since been washed away, with the exception of two small rocks which stick up out of the water like teeth between the islands.

Khar and the Jairli islands are shown on the Russian map. They are all quite small, and I was not able to visit them.

Notes on Route from the Eastern Shore of Lake to Tabriz, and to Urmi round the Southern End of the Lake.—The best landing-places on the eastern shore of the lake are either on the rocky spurs of Mount Shahi, or at the foot of the hills to the south of Khanaga. The latter is generally the best, because the traveller who has disembarked on Mount Shahi may find himself cut off from the mainland by the swamp which exists during many months of the year. I landed at Yaram yatach in an excellent little cove open to the south, but sheltered on the west by a promontory of trachytic rock with quartz veins and nodules.

After the usual delay, horses were produced by the chief man of the village of Ramanlui, and we were able to proceed to Tabriz by a route very similar to that about to be described in the reverse direction.

Tabriz, the commercial capital of Persia where "merchants make large profits" (Marco Polo), has been described so often that I will confine myself to recording two scandals of but, I hope, transitory nature. When we arrived at Tabriz on August 28, we were unable to obtain any bread except at the most exorbitant prices. There was no lack of wheat in the country—indeed, the harvest was of the most fruitful; yet, owing

to the corruption of the Government, there was a famine in the city. Every day the starving multitudes of Tabrizlis might be seen fighting for the few loaves round the bakers' shops in the bazaar. It seems that certain persons, said to be friends of the governor, had bought up all the wheat, had made a "corner" in it, and refused to sell except at famine prices. Fortunately, I was soon relieved of all unpleasant reflections on the subject by the kindest of hosts, Mr. Cecil Wood, H.M. Consul-General at Tabriz.

A far more lamentable matter than the speculation in corn is that one of the finest works of art in Asia, the magnificent Blue Mosque, is not better cared for. Originally a Sunnite temple, it was put to the most degrading uses by the Shiites; and its superb walls are being continually stripped of their priceless tile work by ignorant and ruthless hands. A few years ago the entrance to the interior was boarded up, and a wall was thrown round the fabric; but although by such means some would-be sacrilegious spoilers may be kept at a distance, yet others are the better screened from observation.

On September 1 I reluctantly left Mr. Wood's hospitable roof, and soon joined the great track to Maragha, which skirts the western slopes of Mount Sahend and its outliers at such an elevation as to be well above the low land liable to floods. At some 9 miles from Tabriz, the stony road, after traversing a small ridge of gravel conglomerate hills, descends to the village of Sardarud, with its long bazaar of greengrocers' and saddlers' stalls. Then follows a wearisome plain for another 10 miles. At Irindji, the gravel hills to the east exhibit a very conspicuous horizontal stratum of a hard sandstone lying near their summits.

Owing to the season of the year, I was able to continue my march to Gogan by a short cut across a flat mud plain overgrown with coarse grass. When I rode over it, its sun-cracked surface was hard enough, but in spring it is a swamp. At such times the Shahi peninsula becomes an island. In former years, tradition asserts that the level of the lake was higher, and that the Shahi was an island all the year round, so that, in 1265, when Hulagu was buried on Mount Shahi, the dulness of its island solitude was mitigated by the simultaneous interment of one of his wives. More convincing testimony concerning the former height of the waters of the lake is afforded us by marks of erosion on the hills near Ilghichi (Houtum-Schindler), and by the fact that, whereas the main caravan route from Tabriz to Maragha formerly passed through Dekhargan, now it passes through Gogan, a large town lower down the same valley.

In the village of Dekhargan is an enormous plane tree of great age, shading three curious Moslem tombstones representing animals. In the Urmi basin large trees are extremely rare, and are generally regarded as holy trees. In Persia holy trees are often planes; one in the vicinity of Shiraz is referred to by Chardin as being overhung with

amulets and rags. The Rev. S. J. Daltry records another near the sulphur springs on the hills north of Gavilan.

Beyond Gogan the track crosses some rough limestone hills, which hide the lake completely; to the east rises a group of remarkable basaltic hills, whose abruptly truncated summits are conspicuous for miles around. The well-known Maragha marble is quarried at Daschkiesen, on the south-west slopes of the calcareous hills. The quarries lie to the west of the road as it descends to an iris-covered plain, separating the calcareous hills from a ridge of slate hills, which reach from Khanaga southwards as far as Adjebshir and Khanian. The slate rocks underlie the Maragha marble limestones.

In Maragha the marble has been very extensively employed for building purposes, and both in the town and in the adjacent villages large slabs have been erected for use as public castor-oil crushing tables. The magnificent carved slabs of this material in the Blue Mosque at Tabriz have been admired by all travellers, and Lord Curzon of Kedleston has recognized slabs of the same handsome material as far away as Samarkand. It is deposited from spring water in the form of horizontal layers, which may reach a thickness of 7 to 8 inches. The temperature of the springs was 69° Fahr. in September.

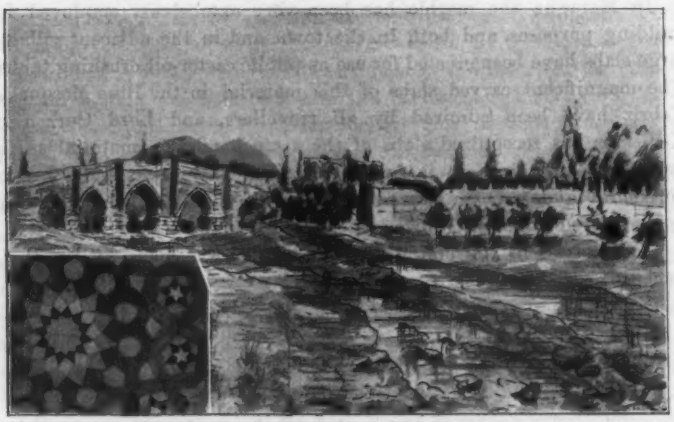
An analysis of the Maragha Onyx marble was made by Mr. R. L. Packard, with the following results:—

$CaCO_3$	90·93
$MgCO_3$	0·75
$FeCO_3$	1·37
$MnCO_3$	4·34
$CaSO_4$	2·30
$Ca_3(PO_4)_2$	0·24
	99·93

It thus appears to be remarkable, as compared with other travertines, in that it contains an unusually large proportion of manganese carbonate. The proportion of magnesium carbonate, on the other hand, is small.

Soon after leaving Khanian, the road turns round the south-westerly buttresses of the Sahend, and proceeds almost due east to the picturesquely situated village of Alku. The flat-roofed houses are clustered at various levels on and around a small hill, and thus are in pleasing contrast to those of the villages of the plains. On many of the roofs were heaped the large stacks of yellow straw and dark-grey *kiziks* (briquettes of manure for fuel). Then, still skirting the slopes of the Sahend, and crossing several dry torrent beds cut in the familiar sandstone and gravel hills (Appendix, 4, *a*–*e*), we at last descended to the gardens, which always announce the proximity of a Persian town. We entered Maragha by one of the two handsome red-brick bridges built by Hulagu over the Safi Chai.

The hills near Kirjawa, some three hours east-south-east of Maragha, are classic ground to the palæontologist. Here are to be found the fossilized bones of a Pliocene mammalian fauna, which Dr. Forsyth Major informs me is very similar to the corresponding fauna of Samos and Pikermi, in Greece. During the two hours which I was able to spend in the search for bones, I found fragments of mastodon, pig, antelope, gazella, rhinoceros, and the Pliocene horse, *Hipparion mediterraneum*. I am convinced that a more prolonged search would be rewarded by the discovery of complete skeletons embedded in the tufa deposits (Appendix, 5).



BRIDGE OVER THE SAFI CHAI, MARAGHA.

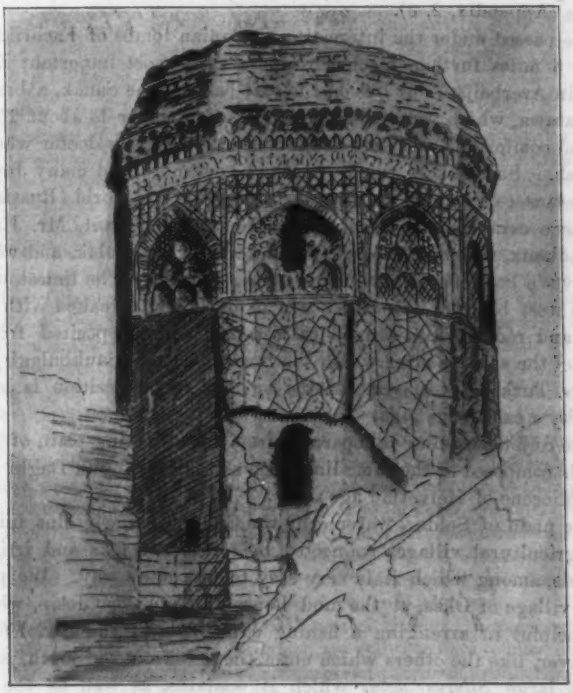
The mud walls of the town are seen on the right. The inset represents the geometrical tilework upon the tower near the eastern end of the bridge.

On leaving Maragha, our route lay between avenues of jujube and walnut trees, through gardens watered by tributaries of the Safi Chai; later, the plain gave place to hills which were composed of slaty rock, and were occasionally capped by deposits of white friable tufa, very like those of Kirjawa (Appendix, 5). Halfway to Miandab, the Murdi Chai has to be forded—an easy matter in September, but probably not so earlier in the year. More slate-hills, and then a conglomerate ridge form the water-parting between the Murdi valley and the large plain of Miandab, drained by the Djaghatu.

A more direct road from Tabriz to Miandab passes through Binab on lower ground nearer the lake. It is conveyed on a causeway across the land most liable to be flooded. In spring, the waters have occasionally been known to reach the little knoll of Binab itself.

Miandab, or Merhemetabad, is a town of five thousand people, on the

western bank of the Djaghatu Chai, and therefore lies between it and the Tatawa Chai (Miandab = between two waters). The Djaghatu is the largest river flowing into Lake Urmi. When I crossed it on September 7, its width was only about 400 feet, and its swift current was only about 2 feet deep in the middle; but in December, Schindler found it to be 600 feet broad, and 3 to 4 feet deep, and in January quite unfordable. In places it must be quite 1500 feet broad, and dangerously deep. Wherever irrigation channels can be made to reach, there are



TOMB OF THE MOTHER OR DAUGHTER OF HULAGU AT MARAGHA.

gardens and vineyards. Flax, cotton, rice, tobacco, melons, and opium, all do excellently in the rich black alluvial soil. Castor-oil plants grow to a height of 7 or 8 feet, and make extremely handsome plants in sheltered situations. Miandab seemed to have completely recovered from the havoc wrought by the Sunnite Kurds in 1881, when three times their number of craven citizens philosophically watched them from the hills at no great distance.

About 3 miles out of Miandab is the Tatawa Chai, which forms the

boundary between the Turki-speaking Shiahs and the Kurdish-speaking Sunnis. The Tatawa and Djaghatu both flow through the same flat plain at no great distance apart; and since their channels are separated by no high ground, their flood waters mix and flow together over the broad marshy plain. In the drier places the uncultivated land was clothed with a rather sparse covering of sun-dried coarse grass, and the broad green leaves of a statice which had flowered earlier in the year. In the moister hollows grow iris and reeds. The main channel of the Tatawa is separated from its Sujbulak tributary by hills of rhyolitic nature (Appendix, 2, 3).

We passed under the interesting Sassanian tombs of Fachrikah, and about 8 miles further reached Sujbulak, the most important Kurdish town in Azerbaijan. It lies on the east bank of the Sanak, a branch of the Tatawa, which was reduced in size in September to about 150 feet. I found comfortable quarters in the house of a Syrian doctor who spoke English. Sujbulak is ruled over by a governor; and many Jews and Armenians carry on its business with the outside world (Russia). In the large caravanserai I met the Armenian merchant, Mr. Hardoun Soulzadiantz, who had collected Coleoptera for Dr. Polak, and who still preserves a bottleful as a memento of his labours. The limestone hills on the west bank of the Sanak are patched and streaked with white, grey, and reddish iron-stained calcareous matter deposited from the water of the springs after which the town is named (Saukbulagh = cold springs, Turkish). In some of the springs the deposition is brought about by a calcareous alga.

The Sujbulak valley is separated from the adjoining plain of Solduz by hills composed of the same limestone as that of Koyun Daghi in the lake (Miocene of Helvetian age).

The plain of Solduz, watered by the Gader Chai, contains innumerable agricultural villages connected by tortuous tracks and irrigation channels, among which it is very easy to lose one's way. We put up in the village of Oksa, at the mud house of Shamasha Josip, who was most helpful in arranging a fishing expedition in the Gader for me. This river, like the others which enter the lake from the south, is noted for the large *Silurus glanis* which it contains, as well as the chub, capoeta, and roach. Water-tortoises (*Clemmys caspia*) and fresh-water crabs (*Telphusa fluviatilis*) are very common. A ridge of hills separates the grazing-land of Solduz from the tilled fields of the plain of Urmi.

In conclusion, it may be observed that the phenomenon of the rise and fall of the waters of Lake Urmi is one which is well worthy of the attention of the scientific geographer. The recent rise observed chiefly on the western side of the lake may only be due to increased rainfall or diminished evaporation, but at the same time there is just a possibility that it is due to some slow earth-movement. For the proper

elucidation of the problem, it is of great importance that an accurate survey of the lake should be made, and that bench-marks should be set up at appropriate places. The observations of the height of the water-level could then all be referred to the same standard marks. Without such marks, it is almost impossible to accurately compare observations made at different spots on the ill-defined marshy shores.

APPENDIX.

Petrographical Notes on Rock-specimens collected by Mr. R. T. Günther in the Neighbourhood of Lake Urmi, Persia.

By Mr. G. T. Prior, M.A., British Museum.

1. Specimens from Bezau Daghi, west side of Lake Urmi.

(*a*) *Pumiceous Hornblende-biotite-andesite.*—The specimen is a rounded block of a white pumiceous rock speckled with small black hornblende crystals and scales of biotite, and showing small crystals of glassy felspar. Under the microscope the felspars are seen to be mostly fragmentary; they show marked zonal structure, and twin laminæ give symmetrical extinction of about 15° (oligoclase-andesite). The hornblende also occurs in small ragged and apparently broken crystals; it has pleochroism: a = pale brownish-yellow, b = dull greenish-brown, c = dull olive-green. These phenocrysts, with biotite and grains of magnetite, are scattered through a colourless, highly vesicular glass. This rock is almost precisely similar to a specimen in the British Museum belonging to the collection made by W. R. Loftus, and labelled "Arin, Lake of Van."

(*b*) *Porphyritic Hornblende-biotite-andesite.*—This is a dark grey rock, showing porphyritic glassy felspars in large amount, with a little biotite and hornblende. The felspar phenocrysts show zonal structure, and, except that they are more perfectly developed, are similar in character to those of the preceding rock. The hornblendes are larger and show slightly different pleochroism: a = pale yellow, b = brown, c = greenish-brown. Most of the sections, however, are parti-coloured, green and brown, as though exhibiting a passage from the green hornblende of the preceding rock to a brown variety. The dense base crowded with dusty material has little action on polarized light, except in parts which present a peculiar mottled appearance, as though from the imperfect development of felspars.

(*c*) *Hornblendic Schist (Epidiorite?).*—This rock presents characters somewhat similar to those of hornblende-schists which are stated to have resulted from the metamorphism of dolerites. It consists of strings and patches of uralitic hornblende (with pleochroism from pale brownish-yellow to dull bluish-green), with interspaces filled with somewhat turbid felspars and a little quartz; irregular patches of sphene occur, generally surrounding grains of iron ore (probably ilmenite, from the alteration of which the sphene has resulted). The rock is similar in character to many of the metamorphosed dolerites (epidiorites) of the Penzance district in the Museum collection; it is almost precisely identical with a specimen of hornblende-schist in the Loftus Collection from Anjulukh Daghi, between Somai and Salmas. This rock is probably connected with the old metamorphic and granitic series of rocks referred to by Grewingk, Loftus, and Blanford as occurring to the north and west of Lake Urmi. In the Loftus Collection in the Museum are specimens of granitic and gneissic rocks and serpentine from near Ushnu to the west of the lake; while from Wurgawiz Daghi on the north-west shore comes a very typical example of pyroxene-granulite with pleochroic hypersthene; and from Guverchin Kala, a

promontory projecting into the lake, a specimen of the granite with pink felspars, referred to by Loftus in *Quart. Jour. Geol. Soc.* xi. (1853), p. 305.

(*d*) A rolled pebble of *reddish quartzite* consists of a medium-grained aggregate of angular fragments of quartz and some felspar, with cross-hatching suggestive of microcline; the interspaces are filled with a finer aggregate of quartz and felspar, while strings of red ferruginous matter throughout the slide indicate incipient foliation. Many of the quartz grains show undulose extinction, and the numerous cracks traversing the specimen show that the rock has been subjected to considerable pressure.

2. Sujbulak, south of Lake Urmi.

Fragmentary Rhyolite?—This is a pale green felsitic-looking rock, showing small opaque white felspars and numerous minute vesicular cavities filled with red ferruginous material. Under the microscope it is seen to consist of rounded and broken fragments of quartz and felspar in a greenish microfelsitic base showing flow-structure and, in parts, indications of perlitic structure.

3. Road from Miandab to Sujbulak.

Rhyolitic Breccia?—This dark grey felsitic rock shows under the microscope rounded patches of microfelsitic material, with a few broken fragments of quartz and felspar in a finer-grained microfelsitic base, rendered dense by a greenish-brown alteration product. In some of the coarser-grained microfelsitic patches curved lines of this green alteration product give a distinct suggestion of perlitic structure.

4. Pebbles from the hillside one hour's march north-east of Maragha.

These consist of andesites of varying basicity, from hornblende-andesite to hypersthene-hornblende-andesite and augite-hypersthene-andesite with olivine (basalt).

(*a*) *Hornblende-andesite.*—This is a pink rock showing phenocrysts of glassy felspar and small hornblendes. Under the microscope the felspars show albite and pericline twining and zonal structure; twin lamellæ give symmetrical extinctions of about 15°. The hornblendes show sharply defined outlines of prisms and pinacoids, but are all altered. The rather dense, unindividualized base contains small rectangular sections of felspar.

(*b*) *Hornblende-biotite-andesite.*—A light pinkish-grey rock similar to the preceding, with the brown hornblendes less altered. Deep reddish-brown biotite is also present.

(*c*) *Hornblende-hypersthene-andesite.*—A grey, rather more compact rock than the preceding, showing felspar phenocrysts. Under the microscope the larger zonal felspars are similar to those in the preceding rocks, and give low symmetrical extinction angles (from 6° to 15°); but other smaller felspars which do not show zonal structure are more basic, and give symmetrical extinctions of from 25° to 30°: in the base is a second generation of small felspars in large amount. The brown hornblende phenocrysts are not numerous. Biotite is present in small amount, intergrown with hornblende. The hypersthene only occurs in minute prismatic crystals in the base: they show straight extinction, and some of the larger ones give the usual pleochroism from very pale green to rose-colour. The base appears to be a colourless glass, with globulites and rod-shaped microlites.

(*d*) *Hornblende-hypersthene-andesite.*—In this light grey rock the porphyritic felspars are smaller and less prominent, while the ferro-magnesian constituents are in larger amount than in the preceding rock. The pleochroic hypersthene occurs in porphyritic prismatic crystals of the same size as the hornblendes, and not in the base: the latter consists of a felt of every minute felspar needles with grains of magnetite and probably some glass.

(*e*) *Augite-hypersthene-andesite with Olivine* (*Basalt*).—This rock is of a much

more basic type; it is of a dark grey colour, showing small phenocrysts of altered felspar and pyroxene. The twinned felspars give symmetrical extinctions of about 25°; beside the larger phenocrysts, there is a second generation of smaller prismatic felspars scattered through the base. The pyroxene phenocrysts are mainly of a monoclinic augite, slightly pleochroic, from very pale green to pale yellow: the hypersthene is only in small amount. The base consists of rather indistinct felspars with magnetite grains and a very little granular augite. Scattered through the slide are a number of small orange-red pseudomorphs after olivine.

5. Kirjawa bone-deposit, east of Maragha.

Pumiceous Tuff.—This is a pale brown tuff containing lumps of pumice. The pumice consists of a colourless, highly vesicular glass showing flow structure, and containing fragments of plagioclase felspars and minute needles of green hornblende, similar to that in the pumiceous andesite from Bezau Daghi, described above.

6. Seir conglomerate pebbles.

(*a*) *Granitic* rock with microcline, and showing cataclastic structure.

(*b*) *Felsite* and quartz grit.

(*c*) *Limestone* fragments with fossils.

NOTES ON GLACIERS OF SOUTH-EASTERN ALASKA AND ADJOINING TERRITORY.*

By OTTO J. KLOTZ, Canadian Topographical Survey.

The writer first visited South-Eastern Alaska in 1889, and spent the seasons of 1893 and 1894, with a steamer at his disposal, along the continental shore-line, in connection with the International Boundary Survey. These notes are, therefore, incidental to other work.

In 1894 a photo-topographic survey was made of the front of the Baird glacier for the study of its motion. The results were published in the *Journal of Geology*, vol. iii. No. 5 (1895), and may be briefly summarized :—

Photographs (photo-topographic camera) taken May 15, 19, July 13, and August 11; base-line, 850 feet, about 1700 feet from glacier, which has a frontage of a mile. Between July 13 and August 11 the end of the Baird glacier was lowered by melting a little over 2 feet, and the average motion of the ice in that part was 1 foot per day. The slope was 1 : 3; the slope of the glacier itself for 15 miles in a straight line is 1 : 20, or nearly 3°. The mean slope of the Patterson glacier, lying south-east of the Baird, is in 10 miles, 1 : 13, or 4° 25′.

The Canadian International Boundary work covers the land area—some 14,000 square miles—adjoining the continental shore-line from Mount St. Elias to Portland canal, and is delineated on twenty-four sheets of 1°—latitude and longitude—contour-lines 250 feet intervals; scale 1 : 160,000, besides one covering the whole on a scale of 1 : 960,000. The topography—contour-lines—is based solely on the camera, and, as such, is the largest photo-topographic survey made anywhere.

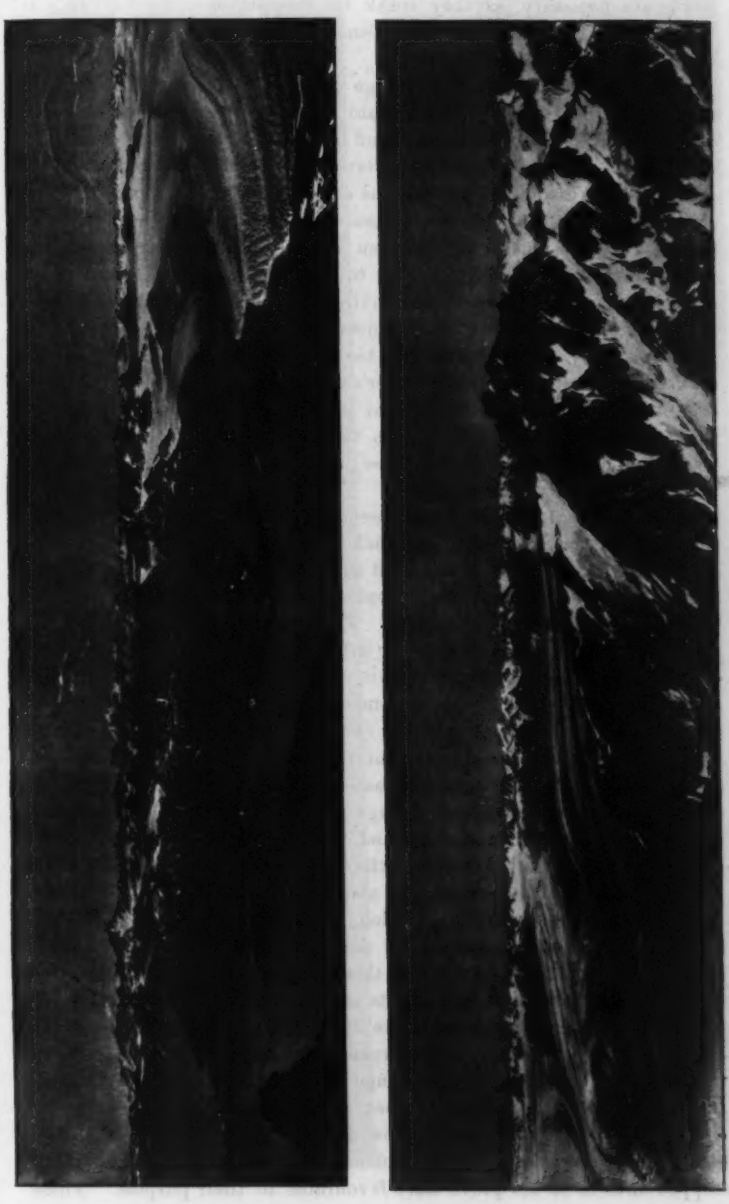
* Maps, p. 592.

The following notes are based on a comparison between the surveys of La Perouse and Vancouver and ours (1893).

The scientific expedition of La Perouse made a lengthened stay with the *Boussole* and *Astrolabe* during July, 1786, in Lituya bay, making at the time a detailed survey of the T-shaped arm, a chart of which on a large scale (1 inch = four-fifths statute mile) is given in his atlas, and is here reproduced, together with one for the same bay enlarged to the same scale from our 1 : 160,000 sheet. Before making a comparison, La Perouse's description of the bay will be given ('Voyage Round the World,' vol. ii. pp. 85–87).

"To form an idea of it, it is necessary to conceive a basin of water, unfathomable in the middle, bordered by peaked mountains of great height, covered with snow, and without one blade of grass to decorate this vast heap of rocks, condemned by nature to eternal sterility. I never beheld the surface of the water ruffled by a single breath of wind. Nothing disturbs it but the fall of enormous masses of ice, which frequently separate from five different glaciers, while the sound is re-echoed by the distant mountains. The air is so calm, the single voice of a man may be heard half a league, as may the cries of a few sea-fowl, which deposit their eggs in the hollows of the rocks. It was at the head of this bay that we hoped to find channels by which we might penetrate into the interior of America. We conjectured it might lead to some large river, taking its course between two of the mountains, and originating from one of the great lakes north of Canada. Such was our chimerical notion, and this was its result. We set off in the two large barges of the *Boussole* and *Astrolabe*. Messrs. de Monti, de Marchainville, de Boutervilliers, and Father Receveur accompanied M. de Langle, and Messrs. Dagelet, Boutin, Saint-Ceran, Duche, and Prevost were with me. We entered the channel on the west. Prudence required us to keep some distance from the shore on account of the falling ice and stones. At length, after having rowed a league and a half-mile, we found the channel terminated at two vast glaciers. We were obliged to push away the flakes of ice with which the sea was covered to penetrate thus far, and the water was so deep that I could find no bottom at half a cable's length from the shore with a line of 120 fathoms. Messrs. de Langle, de Monti, and Dagelet, with several other officers, attempted to ascend the glacier. With unspeakable fatigue they advanced 2 leagues, being obliged at extreme risk of life to leap over clefts of great depth; but they could only perceive one continued mass of ice and snow, of which the summit of Mount Fairweather must have been the termination. . . . I had sent M. de Monneron and M. Bernizet to explore the eastern channel, which terminated like this, at two glaciers. Both these channels were surveyed, and laid down in the plan of the bay."

With reference to the two accompanying charts of Lituya bay, few



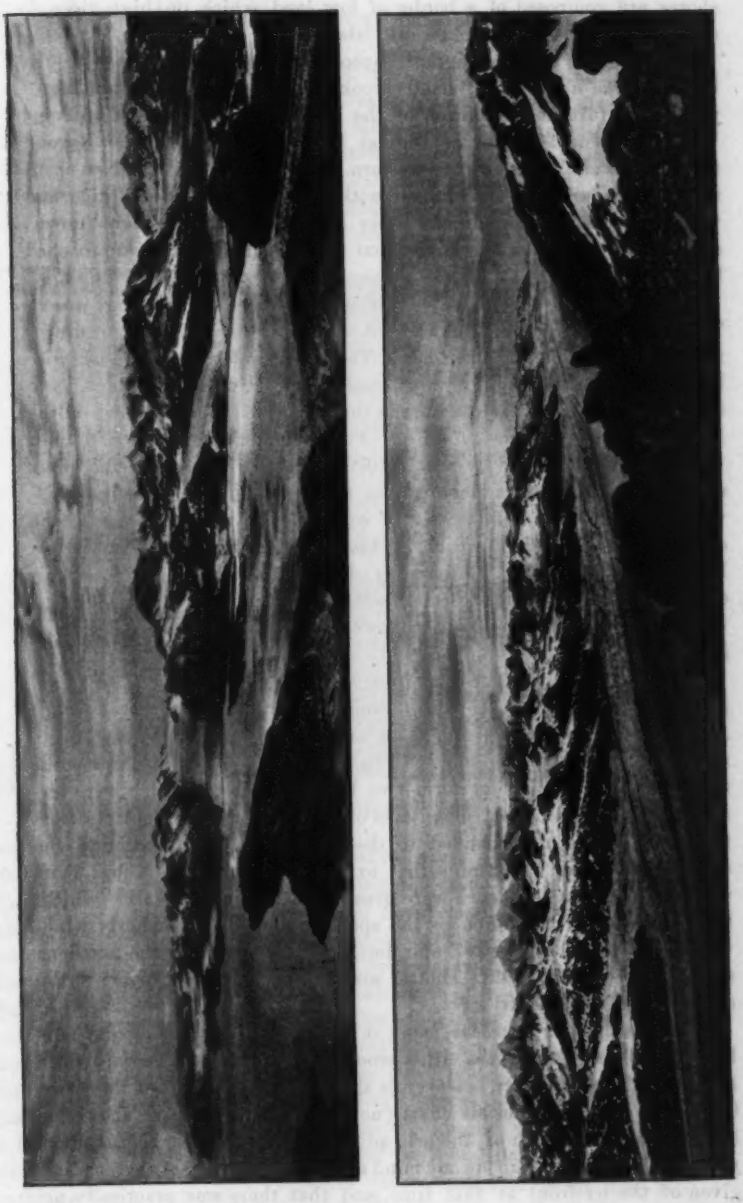
PANORAMA OF MUIR GLACIER.

words are necessary, as they speak for themselves. La Perouse's is from a hydrographic survey; the Canadian from a topographic survey, and the two are fairly accordant.

It will be seen that the two large glaciers of the northerly arm are now united, and have advanced into the arm fully 3 miles, and into water where La Perouse failed to find bottom at 120 fathoms. Similarly, the glaciers of the southerly arm have united and advanced about $2\frac{1}{2}$ miles. These distances represent the sum of the fluctuations during the century. Of the fluctuations themselves we at present know nothing. On La Perouse's chart will be seen a small glacier near the middle of the northerly arm and reaching to the water; on the recent chart this glacier is still shown, but as having receded from the water's edge. We have, therefore, the apparent anomaly of advance and recession of glaciers side by side. Perhaps not too much weight should be given to La Perouse's sketching (to the water's edge) of this small glacier. However, the proof of the advancement of the large glaciers is incontrovertible. It is not the intention, in the present paper, to enter into a discussion of the climatic or other reasons that brought about this change, but simply to state facts.

Leaving now Lituya bay and proceeding some 45 miles south-easterly, we come to Cape Spencer, from which point Mr. Whidbey, under Vancouver's direction, made a connected survey of the continental shore-line along Cross sound, Lynn canal, Stephen's passage, and Frederick sound to the muddy waters of the Stikine. For the purpose of this paper, the most interesting part of this survey is from Cape Spencer to the vicinity of Point Carolus. I have plotted his courses through this interval, and am satisfied of their accuracy by comparison with our survey.

Let me quote from Vancouver (vol. v. pp. 416, 417): "He (Whidbey) commenced on the forenoon of the 10th (July, 1794) from Cape Spencer, with very thick, foggy weather; this inconvenience, in addition to the immense numbers of huge pieces of floating ice, very much retarded his progress across the sound. Having at length effected this object, the continental shore from the cape above mentioned was found to take nearly a north direction for about three leagues to a low pebbly point; north-north-west from which, 5 miles further, a small brook flowed into the sound, and on its northern side stood the ruins of a deserted Indian village. To reach this station, the party had advanced up an arm about 6 miles wide at its entrance, but which had decreased to about half that width, and there further progress was now stopped by an immense body of compact perpendicular ice, extending from shore to shore, and connected with a range of lofty mountains that formed the head of the arm, and, as it were, gave support to this body of ice on each side. Their course was now directed across the arm and on its eastern side; compelled by the inclemency of the weather, the party stopped until it should prove more favourable to their purpose. These



PANORAMA OF JOHNS HOPKINS GLACIER.

shores are composed of a border of low land, which on high tides is overflown and becomes broken into islands."

Although in this description Vancouver does not state how far the ice-front was above the "small brook" or "deserted Indian village," yet, in his further description of the next inlet or arm east of Point Wimbledon (now known as Dundas bay), we find, p. 419: "Beyond them (islets and rocks) on the western shore was a small shallow opening that appeared to communicate with one of a similar description, and which had been noticed in the other arm (Taylor bay as now known) a few miles below the icy barrier, but was too shallow to be approached by the boats."

This, then, gives us a pretty fair idea of where the ice-front was in Taylor bay. I have designated by A (see chart) the "shallow opening" in Dundas bay, and by B the one in Taylor bay referred to, and likewise have plotted the position of the "small brook," "deserted village," and ice-front. The main fact elicited is that the glacier (now known as the Brady) has advanced over 5 miles. Furthermore, the "deserted Indian village" is now covered by nearly 1000 feet of ice; similarly, the brook and, besides, the waters flowing from that part of the glacier now flow westward into the Pacific instead of southerly. An examination of the chart furnished the explanation. This advancement within exactly one hundred years is large; the burying of the village under so vast a load of ice adds interest to this glacial motion, which, however, is far eclipsed by the phenomenon of opposite character—recession—in the neighbouring Glacier bay.

Let us again quote Vancouver (p. 421) for the description of that which is now designated as Glacier bay: From "Point Dundas, situated in lat. 58° 21′, long. 224° 1′, the coast takes an irregular east-north-east direction about 7 miles to a point. . . . To the north and east of this point the shores of the continent form two large open bays, which were terminated by compact solid mountains of ice, rising perpendicularly from the water's edge, and bounded to the north by a continuation of the united lofty frozen mountains that extend eastward from Mount Fairweather. In these bays also were great quantities of broken ice, which, having been put in motion by the springing up of a northerly wind, was drifted to the southward, and, forcing the boats from the northern shore, obliged them to take shelter around the north-east point of the above island" (Lemesurier).

From Vancouver's measurement, it would appear that the point now known as Point Carolus has either emerged or advanced eastward since his time. The main fact, however, is the position and limit of the "two large open bays." From his chart (not given here) they are shown as less than half the depth of the arm adjoining Cape Spencer, *i.e.* about 5 miles. There is no doubt in my mind about the accuracy of the position given of the ice-front at that time, and that there was practically no

Glacier bay save the relatively small indentations compared with the present bay.

Referring to the chart of 1894, it will be seen that the ice-front of 1794 has receded upwards of 45 miles in a north-westerly direction, and that part, so well-known as the Muir glacier, has receded 25 miles. The latter glacier has been fully described by Prof. John Muir, Prof. G. F. Wright in *American Journal of Science* for January, 1887, and also by Prof. Harry Fielding Reid in the *National Geographic Magazine*, vol. iv., March, 1892. Willoughby island, with an elevation of 1545 feet, gives

LOOKING WESTERLY, JOHNS HOPKINS GLACIER TO RIGHT.

ample evidence of having been entirely covered with ice recently, and the ice-markings on mountains adjoining the eastern (1894) terminal of the Muir glacier are at an altitude of about 2500 feet, from which we obtain the maximum slope of the glacier between those points to have been 32′, which is very small compared with those given for the Baird and Patterson. However, even at that small angle of incline we would find the depth of the glacier to be 3400 feet where now the Grand Pacific and Johns Hopkins glaciers discharge into this bay. From that point of elevation it seems probable that the ice would seek the shorter route to the sea and move towards Taylor bay, into which now the Brady glacier discharges. At the present time the ice over this stretch moves in both directions, one south into Taylor bay, the other north into the north-west arm of Glacier bay. A future examination of the ice-markings below the 4000-foot level on the rocks south of the above

north-west arm will definitely settle the direction of the former ice-flow there.

From the preceding we see, therefore, that we have two ice-streams, whose mouths are within 20 miles of each other; the one has receded within a hundred years fully 45 miles, while the other has advanced over 5 miles. Abut this the proofs seem absolutely conclusive.

Of the other glaciers along the continental shore-line, eastward from Glacier bay as far as the Stikine, we have no survey or measurement by Vancouver (or any one else) to enable us to make comparisons with their present position, and for that purpose must rely simply on his general description of them. Reading Vancouver carefully, and from the writer's intimate knowledge of that continental shore-line, I think I am correct in saying that in that latter region all the glaciers have receded since the days of that illustrious explorer.

It seems somewhat strange that Vancouver does not mention what is now known as the Davidson glacier; although, in passing close in-shore, the woods on the terminal moraine may have hidden it, yet he must have seen it from the opposite shore afterwards.

As the works of Vancouver are probably not very accessible, and for future reference, it is considered desirable to quote some extracts pertaining to glaciers.

Of the head of Chilkat inlet, Lynn canal, at the mouth of the Chilkat river, we find (p. 426, July, 1794), "It was here remarked that, notwithstanding the quantity of fresh water which flowed into this arm from the brook just mentioned, the shores were perfectly free from ice, although they were three-fourths of a degree to the north of those parts that had undergone the examination of the party in the early part of their present expedition, where they had been much annoyed by ice, and it became another instance of the local existence of these substances."

Of the channel (Gastineau) lying between Douglas island and the mainland, we read (vol. vi. p. 20), "About three leagues up this arm is a small islet nearly in mid-channel. This afforded another instance of the partial existence of the ice, which here entirely blocked up this arm." And again, on p. 25, when returning from Barlow's cove, down Stephens passage, "The point on which the northern village is situated was found to be, as had before been conjectured, the west point of entrance into the narrow icy arm (Gastineau). . . . The channel between this island and the mainland, being rendered by the ice impassable, the boats were steered over to the southern shore for protection against the south-east wind." At the present time ice is occasionally drifted into this channel from Taku inlet, but certainly not to the extent described by Vancouver. More must then have been discharged from Taku inlet, and possibly some from the Mendenhall at the west entrance, which now, however, does not reach tide-water.

Of Taku inlet Vancouver says (vol. vi. p. 26, August, 1794), "in which the great quantity of floating ice, with a strong northerly wind against them, so retarded their progress that a passage was with great difficulty effected. . . . From the shore of this basin" (north of Taku point) "a compact body of ice extended some distance nearly all round. . . . From the rugged gullies in their sides were projected immense bodies of ice that reached perpendicularly to the surface of the water in the basin, which admitted of no landing-place for the boats, but exhibited as dreary and inhospitable an aspect as the imagination can possibly suggest."

LOOKING NORTHWARD OF LITUYU BAY, SHOWING ONE ICE-FRONT.

At the present time there is only one glacier (Foster) discharging directly into the sea, the others having receded, and the gullies are not now so generally filled with ice.

Coming further south; of Holkham bay we find (vol. vi. p. 29, August, 1794), "Much floating ice was seen within the islands" (near the middle at the entrance of the bay). Little or no ice is found there now. In the neighbouring Tracy arm and Endicott arm quite a quantity of small floes may be met, and occasionally pieces are floated out into Holkham bay and Stephens passage. The inference is, therefore, for a diminution. These two arms show unmistakable signs, by their bare marked rock walls, of recent recession.

Sir George Simpson, writing of the same neighbourhood in September, 1841, says, in his 'Journey Round the World,' vol. i. p. 213, "Next

morning we passed through Wrangell straits and Prince Frederick's sound, respectively 22 and 57 miles long, and halted for the night at the entrance of Stephens passage. The valleys were lined with glaciers down to the water's edge; and the pieces that had broken off during the season had filled the channels and straits with fields and masses of ice, through which the vessel could scarcely force her way. Starting again at five in the morning, with a foul wind and thick fog, we ran through Stephens passage; and, when the mist cleared sufficiently for the purpose, the land on either side displayed to us mountains rising abruptly from the sea, and bearing a glacier in their every ravine. Earlier in the season these glaciers would have been concealed by the snow, but now they showed a surface of green ice."

This latter description indicates a great diminution of the glaciers in fifty years, *i.e.* subsequent to 1841, and in the quantity of floating ice encountered in Stephens passage, where now only an occasional floe is seen. Simpson speaks of Gastineau channel, already referred to, as being "generally obstructed by ice."

The vicinity of the Horn cliffs, proceeding south-easterly down Frederick sound, is described by Vancouver, vol. vi. pp. 31, 32 (August, 1794): "A few miles to the south of this margin the mountains extended to the water-side, where a part of them presented an uncommonly awful appearance, rising with an inclination towards the water to a vast height, loaded with an immense quantity of snow and ice, and overhanging their base, which seemed to be insufficient to bear the ponderous fabric it sustained, and rendered the view of the passage beneath it horribly magnificent. Soon after passing this very remarkable promontory, the arm of the sea over which it hangs appeared to be entirely enclosed by a beach, extending all round the head of it; at the south-east extremity was a large body of ice, formed in a gully between the mountains that approach the water-side, from whence much broken ice seemed to have fallen and had entirely covered the surface of the water in that direction."

From the latter part of the above, it would appear that Whidbey was near the mouth of the present Le Conte bay, into which discharges the Le Conte glacier, the most southerly (lat. 56° 49′) at present of living glaciers on the continental shore, but the bay seems to have been filled by the glacier, for no bay is shown (on Vancouver's chart) which is now 6 miles deep. It may be stated that the position given for the ice-front of the Le Conte glacier by the United States Coast Survey, and that made some years later (1893) by us, show a recession of fully half a mile.*

* The definite year in which the United States survey was made is not at the moment known to the writer, but it was probably in the later eighties; hence the exact interval cannot be given. Le Conte bay is not mentioned in the United States Alaska Coast Pilot for 1883, but is given in the one of 1891.

Again referring to Vancouver (vol. vi. p. 34), "Mr. Whidbey observes that in no instance during his researches, either in the several branches of Prince William sound, or in the course of his present excursion, did he find any immense bodies of ice on the islands; all those which he had seen on shore were in the gullies or valleys of the connected chain of lofty mountains so frequently mentioned, and which chiefly constituted the continental shore-line from Cook's inlet to this station; though in different places these mountains are at different distances from the seaside. He likewise observes that all the islands, or groups of islands, were of a moderate height, when compared with the stupendous mountains that compose the continental boundary, and

BRADY GLACIER, TAYLOR BAY.

were still seen to continue in a south-eastern direction from this shallow passage, whilst the land to the westward assumed a more moderate height, was free from snow, and produced a forest of lofty pine trees."

The conclusions arrived at are, that the glaciers eastward of Glacier bay have all diminished since Vancouver's time, *i.e.* within the past hundred years. This does not exclude the fact that some dead glaciers may have and have advanced (*e.g.* the Patterson) for a year or so, due to heavy precipitation and accumulation of snow on the *névé*. The mere fact of recession must have tended to raise the average temperature of the area, and thereby still more hasten recession.

There are no meteorological data for that region covering the period

under discussion that might lend their aid in determining the reasons for the variation of the glaciers. Besides the effect of meteorological conditions, we must not lose sight of those due to physiographic changes.

With reference to the encroachment of the ocean and subsidence of the land, Vancouver writes (vol. vi. pp. 53, 54), ". . . He" (Whidbey) "also states that in his last two excursions" (between Cape Spencer and foot of Frederick sound) "several places were seen where the ocean was evidently encroaching very rapidly on the land, and that the low borders extending from the base of the mountains to the seaside had, at no very remote period of time, produced tall and stately timber, as many of their dead trunks were found standing erect, and still rooted fast in the ground in different stages of decay, those being the most perfect that had been the least subject to the influence of the salt water, by which they were surrounded on every tide; such had been the encroachment of the ocean on these shores, that the shorter stumps in some instances at low-water mark were even with or below the surface of the sea. This same appearance has been noticed before in Fort Chalmers, and on this occasion Mr. Whidbey quotes other instances of similar encroachment, not only in Prince William sound, but also in Cook's inlet."

Probably nowhere on the earth are better opportunities afforded for the study of living and dead glaciers than on the north-west continental shore of America. Within recent years the region has become easily accessible, and with the accurate delimitation of the shores and the position of the glaciers in 1893 and 1894, future surveys of the latter will furnish accurate data for the study of glacial motion.

It is desirable that future investigators leave readily recognizable marks near the ice-front (as was done by the writer in the survey of the Baird in 1894, with white lead on the adjoining bare rock wall), as such are preferable for the determination of the smaller fluctuations of the glacier. Whatever methods of measurement and survey are used, it cannot be too strongly recommended that photographs be taken with a camera of fixed and known focal length from a properly oriented base-line. The study of the motion of glaciers will then be reduced to an exact science.

THE SWEDISH EAST GREENLAND EXPEDITION.

(Preliminary Note.)

By Dr. A. G. NATHORST.

The Swedish expedition, under my leadership, to East Greenland in search of Andrée, to which the Council of the Royal Geographical Society had granted a contribution of £100, arrived safely at Malmö September 12. Although the expedition as regards Andrée was unsuccessful—no traces whatever of his expedition having been met with

—it has from every other point of view been a great success. After having made soundings and done hydrographical work in the Atlantic, the expedition arrived at Jan Mayen on June 12, and stayed there till the 24th, making scientific researches and collections, the *Antarctic* being the first Swedish vessel which has visited this interesting island. There were some very fine days, during which Beerenberg exposed itself in all its magnificent splendour. The margin of the ice-pack was met with in the north of Jan Mayen the evening of June 24, and was followed against north-east and north until early on the 27th, when the ice (at 73° 12′ lat., 5° 10′ long. W.) allowed us to make way towards the north-west. The open water between the ice-pack and land was reached July 2, after some very hard work in the last part of the way, the ice being very dense. We reached the coast a little south of Shannon island at 74° 50′, but the island itself could not be reached in consequence of the conditions of the ice and the almost continuous fog. We then examined Pendulum island and Sabine island. On Walrus island a depôt for Sverdrup was erected, and information thereof was laid in different cairns along the coast. Then we landed at Flache bay, Cape Borlase Warren, Cape Berghaus, and Cape Mary (Clavering island), whence we went to Cape Broer Ruys (Hold with Hope) and the coast between this and Mackenzie bay. Franz Josef fjord being still covered by the land-ice, and we having been enclosed in the ice in Foster bay, I went southwards July 22 to Scoresby sound, with the intention of returning northwards to Franz Josef fjord later in the season. The Bontekoe island, as well as Cape Parry, was visited over the land-ice, and then we landed at Murray island, north of Liverpool coast. This coast being almost free from ice, we landed in Holloway bay, and thence went to Scoresby sound, where we anchored at Cape Stewart, July 29. Here the house and depôt of Lieut. Ryder were examined, but no traces of Andrée were found. I then went up Hurry inlet, and anchored north of the Fame islands, where we dwelt until August 7. The whaler *Balæna*, captain Th. Robertson, from Dundee, which we had met in the ice as well as at Pendulum island and south of Shannon island, visited us here and took some letters to Iceland on her way to Davis strait. The inner part of Hurry inlet was mapped by Mr. Dusén, and interesting scientific researches were made.

In the evening of August 7, I went from Hurry inlet, and reached Franz Josef fjord, August 9. The land-ice was now gone away or melted, and we reached the bottom of the fjord next morning. The German map of the outer part of the fjord is tolerably good, while the map of the interior is quite wrong, the fjord being in reality narrower and not wider towards the interior, and the interior part lying 2° of longitude farther east than the map indicates. It is thus much smaller than on the map, and the Petermann spitze is probably only two-thirds as high as Payer supposed. A base-line was measured

in the interior of the fjord, and the mapping begun from the *Antarctic*, the fjord being too great to be mapped during boat-journeys, and too narrow and high for mapping in the photo-grammetrical way during the short time at our disposal. The mapping was made by Mr. Dusén, while the astronomical positions were determined by Dr. Åkerblom. We now went outwards, and having, on August 14, entered the southern branch of the fjord east of Payer spitze, found that this branch was a sound (named the Antarctic sound) which led to a hitherto unknown magnificent great fjord, which was named King Oscar's fjord. This fjord stretches southwards to Davy sound, and sends two branches to the eastward, which connect it with the sea. Mountnorris inlet on Scoresby's map is only a bay, Cape Parry and Traill island being in reality connected with each other. On the western side King Oscar's fjord sends two branches into the interior, the southern of which divides in two, the northern in three, branchlets. They go almost as far west as the interior of Franz Josef fjord.

The surroundings of King Oscar's fjord are beautiful and splendid. As Davy sound was covered by thick land-ice, and as this ice also blocked the second outlet eastwards, we were obliged—which we should have done in any case—to return northwards through Antarctic sound to Franz Josef fjord, the mapping of King Oscar's fjord having been finished. It was most interesting indeed to go about 800 nautical miles in these waters, where no ship had plunged its keel before us. On August 24 we returned to Franz Josef fjord, the mapping of which was now continued until the evening of August 30. There were discovered some new branches of this fjord, one of which, east of Waltershausen glacier, stretches itself far eastwards. On the 30th, in the evening, we left the Greenland coast, and had a very easy escape through the ice with exception of the margin itself, the penetration of which took three hours of hard work, almost constantly ramming. At 7 o'clock a.m., September 1, we had left the ice behind us.

The summer must be regarded as unusually fine. We were certainly in the beginning very much hindered by the fog, but from July 29 to August 30 there was sunshine every day, and often calm weather. Even the high mountains (5000 to 6000 feet) around Franz Josef fjord and King Oscar's fjord were never hidden by clouds during our stay there. It was also very fortunate that we had coal enough, for our way in King Oscar's fjord and Franz Josef fjord measured 1044 nautical miles. When leaving Helsingborg, May 25, I had taken 237 sacks of coal on deck, and at my return to Stockholm had still about 70 tons on board. As to the search for Andrée, I regard it as proved that he has not come to this coast; otherwise we should necessarily have found some traces of his expedition, but as such were wanting from 70° to 75° N. lat., he cannot have been here.

The geographical work of the expedition consists of the mapping the interior of Hurry inlet, the discovery of King Oscar's fjord with its

many branches, and the mapping on 1 : 200,000 of this great fjord, and the whole of Franz Josef fjord. The maps will hereafter be totally different from their present appearance. The astronomical observations at Murray's island will also alter the position in longitude of the Liverpool coast. As to the geological work, I will here only mention the discovery of the Silurian and Devonian systems, both of which were hitherto unknown on this coast. From the zoological point of view, we have secured twenty-eight musk oxen, all of which were prepared in some way or another so that we had skeletons, skins, all the interior parts, brains, etc., brought home. Seventeen polar bears and nine reindeer were also secured. A very interesting discovery is the fact that the white polar wolves have made an invasion around the northern part of Greenland along the whole coast, at least to Scoresby sound, where two specimens were seen. A skin was procured from a Norwegian sealer at Clavering island. The reindeer are now very scanty in consequence of their having been killed by the wolves. Also a specimen of the lemming (*Myodes torquatus*) was obtained in King Oscar's fjord. Besides, we have made great ornithological collections, and have dredged everywhere. North of Jan Mayen an *Umbellularia*, which measured 2 meters 12 centimeters in length, was obtained. Also insects, etc., were collected. The botanical collections are very complete, and some specimens new for Greenland or the coast were found, of which I only mention *Pleuropogon Sabinei*, discovered at Hurry inlet, and only once before found in Greenland (by myself at Cape York, 1883). Also great collections of driftwood were made. Hydrographical researches were made as well during our journey northwards as during our return journey in "the Norwegian depth" and other localities, and many hundred bottle-letters were thrown out in order to ascertain the ocean currents. Astronomical and magnetical determinations were made at different localities on the coast. An interesting ethnographical collection was made in the old huts of the Eskimo, who formerly lived on this coast, and eighteen skulls from old graves were brought home.

THE SEVENTH INTERNATIONAL GEOGRAPHICAL CONGRESS

In accordance with the resolution passed at the Sixth International Geographical Congress held in London under the auspices of the Royal Geographical Society in 1895, the Seventh Congress met in Berlin, where all arrangements were carried out by the Berlin Geographical Society, under the presidency of Baron von Richthofen. The preparations for the Congress and the preliminary organization have been referred to frequently in recent numbers of the *Journal*. The building of the Prussian Chamber of Deputies (Abgeordnetenhaus), placed at the disposal of the Congress by the Prussian Government, formed not only a magnificent but a most comfortable place of meeting. The ground floor contained

tables for issuing programmes, etc.; a range of pigeon-holes bearing the numbers of members' tickets for the distribution of abstracts, invitations, etc.; and a large and well-managed cloak-room. On the first floor the great hall for the general meetings occupied the centre, while round it were grouped conversation-halls, reading-rooms, writing-room, restaurant, and a suite of rooms set apart for lady members and associates. Two convenient section rooms were situated on the second floor. The plan of the meetings, as at London, included a general gathering in the forenoon for papers of general interest, and three simultaneous sectional meetings in the afternoon for papers likely to appeal mainly to specialists. In addition there were occasional subsectional meetings in smaller rooms.

The general work of the Congress was carried on in a simpler manner than in London, the daily journal being superseded by a programme giving the proceedings for every day issued beforehand in the three languages. The prominence given to German and French in the written and spoken business of the Congress in London was not on this occasion accorded to English and French. The gathering was in fact less representatively international, though somewhat more numerous than in London. The total membership was about 1600. Amongst those present there were about 205 foreigners, *i.e.* natives of countries outside the German Empire, and of these about 61 were British subjects and 20 Americans. There were about 500 foreigners at the London Congress.

The whole setting of the Congress was in harmony with the splendour of the place of meeting. Social attentions of almost overwhelming generosity were shown by the Imperial Chancellor, the city of Berlin, and the Berlin Geographical Society; while before and after the meeting the members who took part in the various excursions were welcomed with the most lavish hospitality by the geographical societies and municipalities of all parts of the empire.

An informal evening gathering on September 27 served as a prelude to the formal opening ceremonial of the 28th, which took place at 10.30 a.m., when the members met attired in evening dress or uniform, and addresses of welcome were presented. The patron of the Congress, H.R.H. Prince Albrecht of Prussia, spoke in the name of the Emperor, who afterwards exchanged congratulatory telegrams with the Congress; and the Imperial Chancellor, Prince Hohenlohe, expressed the feelings of the Empire. Herr Studt, the Prussian Minister of Education, gave a welcome on behalf of the Prussian government, and the Burgermeister of Berlin on behalf of the city. The President of the Congress, Baron Richthofen, then delivered an inaugural address, the main subject of which was the progress of geography during the nineteenth century, and for this a vote of thanks was proposed by M. Semenoff, seconded by Sir Clements Markham. As President of the

previous Congress, Sir Clements Markham presented the report of the permanent bureau, and laid down his office with the words—

"As President of the permanent bureau of the Sixth International Geographical Congress, it now becomes my duty, and that of my colleagues, the secretaries, to hand over the work to our successors, and to give an account of our proceedings during the four years of our tenure of office.

"The Sixth Congress resolved that the officers of each Congress should continue to act until the meeting of the succeeding Congress, to carry out the resolutions that were passed as far as possible, and to present a report at the termination of their period of office, on the work that had been done in the interval. That report is now presented to the Seventh Congress, and will be considered and discussed in detail. I trust that it will show that the officers of the Sixth Congress have endeavoured, to the best of their power, to carry out the resolutions that were passed, and that any failure to attain the results that were desired is due to faulty organization, and not to any want of diligence. I can testify to the zeal and ability with which the work has been conducted by the able secretaries of the Sixth Congress, Dr. Keltie and Dr. Mill. Their experience will be valuable in deciding upon any improvements in the working of the administration, which may be discussed and inaugurated during the sittings of the Seventh Congress. I may mention one difficulty which we found insuperable. It was the assembly of international committees in accordance with resolutions or with subsequent recommendations. This difficulty, no doubt, among other points, will be considered and remedied by the wisdom of the authorities of the Seventh Congress. Another difficulty was to induce the various geographical societies to enter into correspondence, or to discuss the questions raised by the resolutions passed by the Congress. Scarcely any answers were received to the letters addressed to the societies by the officers of the Congress.

"In spite of these difficulties, five at least of the resolutions entrusted to the officers of the Sixth Congress have been successfully carried out.

"With regard to the triangulation in Africa, recommendations are submitted in our report for the consideration of the Seventh Congress. But I must be allowed to take this opportunity of referring, in high terms of praise, to the German triangulation from Nyasa to Tanganyika, carried out for the most part by Dr. E. Kohlschütter. His English colleague, Major Close, bears testimony that this German triangulation is the best in tropical Africa.

"We also submit recommendations with regard to the proposed map of the world on a scale of 1 : 1,000,000. With regard to the third resolution, we came to the conclusion that the admirable bibliography published by the Berlin Geographical Society fulfilled all the requirements.

"Four other resolutions of the Sixth Congress have been carried out fully, and these are the most important. It was desired that there should be a British representative on the International Geodetic Association. Through the exertions of the officers of the Sixth Congress, the appointment of such a representative has been made. It was desired that seismic observations should be established. They have already been established in several important centres, thanks mainly to the exertions of Prof. Milne. The hydrographic researches in the North sea, the importance of which was recognized by a resolution of the Sixth Congress, will shortly be undertaken, as the result of the Conference at Stockholm, under the combined auspices of the British, German, and Scandinavian Governments.

"But I think that the resolution of the Sixth Congress, which will be most thoroughly and satisfactorily carried out, is that relating to the exploration of the antarctic regions. Well-equipped expeditions will start from England and from Germany in 1901, with funds supplied both by the liberality of private individuals and by grants from the respective governments. The two sources of supply prove that these most important geographical enterprises are not only supported by the enthusiasm of the peoples, but also, owing to a conviction of their utility and of the scientific value of their results, by the two governments.

"I trust that the suggestions in our report will point the way to further improvements in the administrative arrangements of the Congress.

"It is now my very agreeable duty to resign my office as President to so distinguished a successor as Baron Richthofen, now President of the Seventh International Geographical Congress. His leading position as one of the first of living geographers reflects prestige and honour on any assembly over which he may preside; and we, members of the Seventh Congress, have to give him our most especial thanks for the trouble and pains he has taken to render this Congress a great success. Under his presidency it is as sure to lead to valuable scientific results as it is to be agreeable and pleasant to its members.

"There is only one source of regret, and that is the absence, through illness, of the Baroness Richthofen, who is so well known to so many of us, and who will be missed by her numerous friends. That her recovery will be speedy and complete is, I am sure, the earnest hope of all the members of this Congress. I now resign my office as President into the hands of my illustrious successor, Baron Richthofen."

Altogether the programme of the Congress contained 150 papers, a number so great that it was impossible to give a fair chance to all, and several authors, seeing the hopelessness of obtaining a hearing, withdrew their communications or gave them in brief abstract. The audiences were remarkably enduring, permitting many papers of little interest

to be prolonged far beyond the twenty minutes allotted for them; but the result was the curtailment of some interesting discussions. The conclusions of most of the more important papers were embodied in resolutions, which, after being discussed in the sectional meetings, were accepted at the concluding general meeting; the resolutions as finally adopted are given at the end of this article. For the rest, it is only possible to refer to a few of the outstanding papers. The most interesting in many ways was Dr. Nansen's summary of the scientific results of his great arctic drift, with special reference to the depth of the North Polar basin, and the temperature and circulation of water in the arctic sea. Another part of the work of the *Fram* expedition was dealt with by Prof. Mohn of Christiania, who discussed the meteorological observations in detail.

The approaching antarctic explorations were the subject of two papers and some discussion. Dr. Erich von Drygalski, the designated leader of the German expedition, described the general scheme of the intended work, and submitted a detailed description of the vessel and her equipments. Sir Clements Markham described the methods and plans of the British expedition, and both speakers laid stress on the importance of co-operation in the work of antarctic exploration on the part of the two expeditions. M. Arçtowski gave a short account of the scientific results of the *Belgica;* and Prof. Nielsen, of Christiania, described the voyage of the *Southern Cross* to Cape Adare.

Oceanographical papers and discussions were a distinct feature of the Congress. The *Valdivia* expedition was dealt with by its leader, Prof. Chun; the Prince of Monaco described his cruise of last summer on the coast of Spitsbergen; and Sir John Murray discussed the distribution of deep-sea deposits. Questions of uniformity in international usage as to nomenclature and methods of working received a good deal of attention; and as regards oceanographers, the representation at the Congress was remarkably complete and international.

Other departments of physical geography were also well represented. Professors de Lapparent, Penck, and Davis dealt in masterly fashion with various points of geomorphology; Professor Gerland and others took up the question of seismology, and advocated the more earnest international study of earthquake phenomena; while Baron de Geer, Prof. Wahnschaffe, and others gave attention to glacial phenomena. Many important papers on plant-geography were read by well-known specialists, including Professors Engler, Drude, Warburg, Nehring, and Krasnoff, and this subject was perhaps the most thoroughly discussed with the exception of oceanography.

Besides a considerable number of travel papers by German explorers of repute, there were several valuable communications on the physical structure of particular regions. Thus M. Obrucheff discussed the mountain systems of the Trans-Baikal region of Siberia on the basis of

journeys carried out between 1895 and 1898, and Dr. Philippson dealt similarly with the Ægean region.

Historical geography claimed several weighty expositions, one by Prof. Ratzel on the origin and distribution of the Indo-Germanic peoples, and one by Prof. Sieglin on the ancient discovery of England, being specially worthy of remark. In anthropogeography there were also many important papers, and geography in education claimed its due amount of attention.

While it would be impossible to give a list of the 150 or more papers presented to the Congress, it is interesting to notice those contributed by English-speaking people who took part in the scientific work of the meeting to a greater extent than at any of the previous Congresses —that in London, of course, excepted. These papers were—

Sir Clements Markham, On the British Antarctic Expedition.
Mr. John MacEwan, The Geographical Distribution of the Tea-plant.
Mrs. Zelia Nuttall (Cambridge, Mass.), On the Plans of the Ancient American Cities.
Sir John Murray, The Distribution of Deep-sea Deposits.
Dr. H. R. Mill, On the Adoption of Metric Units in Scientific Geographical Work; and On the Terminology of the Forms of Sub-Oceanic Relief.
Major F. J. S. Cleeve, A System of comparing Geographical Distances.
Prof. W. M. Davis (Harvard), The Geographical Cycle.
Mrs. Gordon, On the Basins of Southern Europe.
Mr. Vaughan Cornish, Association of the Study of Waves to Geography.
Dr. J. Scott Keltie, On the Desirability of obtaining more Accurate Knowledge of the Population of Countries where there is no Organized Census.
Dr. F. Boas (New York), The Jesup North Pacific Expedition.
Miss Owen (St. Joseph, Mo.), The Bluffs of the Missouri River.
Mr. Poulteney Bigelow (New York), Colonial Systems.
General Greely (Washington), Communication of Papers on different Departments of the Geographical Work of the United States Government.
Mr. A. L. Rotch (Boston), On Observations on the Upper Atmosphere.

In addition to these authors an active part was taken in the discussions of the Congress by Mr. J. Y. Buchanan, Mr. E. G. Ravenstein, Mr. B. V. Darbishire, Dr. Bryant (Philadelphia), and Mr. Steinthal.

There were no official delegates to the Congress either from countries or societies, but the president of the leading geographical society of each country, if present, was considered as in a special sense representing that country. The whole proceedings of the Congress were simplified by abandoning many of the formalities formerly considered necessary; but, as in previous congresses, formal resolutions were

passed embodying the results of the deliberations, and suggesting directions in which progress can be made. The following is a list of the resolutions passed as distributed at the concluding meeting of the Congress. In addition to those mentioned, some committees of specialists were appointed for particular subjects. The resolutions are arranged according to the departments of geography with which they deal.

RESOLUTIONS OF THE SEVENTH INTERNATIONAL CONGRESS.

International Cartographic Association.—The Congress looks upon the foundation of an International Cartographic Association as desirable, and appoints a committee to undertake preliminary arrangements.

Map of the World on the scale 1 : 1,000,000.—The Congress considers that a uniform map of the world, on a scale of 1 : 1,000,000, would be useful and desirable, each sheet of the map being bounded by meridians and parallels. The permanent bureau of the Congress is charged with taking preliminary steps for the construction of such a map, and first of all with the production of a projection, showing the lines of latitude and longitude on the proper scale for the various sheets.

Population Maps.—The Congress considers the construction of statistical population maps to be extremely desirable. It nominates an international committee, with the right of adding to its number, charged with laying down the fundamental rules for such maps, and to communicate with the geographers of different countries with the view of securing the establishment of national committees, which should take in hand the production of such maps.

Data for the Construction of Maps.—The Congress desires that the publication of all new geographical material should be accompanied by particulars as to the method of surveying, the instruments employed, and their verification, the calculation of astronomical positions with their probable errors, and the method of utilizing these data in the construction of the maps. Also that the maps issued by scientific men, or by official or private geographical institutions, should be accompanied by notes stating at least the chief data used in constructing the maps, and indicating the parts of the maps which are based on more or less satisfactory material.

Natural Scale for Maps.—The Congress expresses an urgent wish that all maps and charts—even those issued in countries using English or Russian measures—should bear in addition to the graphic scale the statement of the linear scale in the form of the ratio between the map and the region it represents (*e.g.* 1 : 500,000); and that this natural scale be quoted in all catalogues of maps. The bureau of the Congress is charged with bringing this resolution to the knowledge of the various governments.

Antarctic Exploration.—Having considered the division of the work of the approaching antarctic expeditions as described in the reports

which have been submitted, the Congress considers that a satisfactory method of international co-operation has been arrived at with regard to physico-geographical, geological, geodetic, and biological investigations. With regard to meteorological and magnetic work, the Congress feels that it is desirable to arrive at a closer agreement, and nominates an international committee with the object, (1) of determining the scope and methods of investigation of the magnetic and meteorological observations to be carried out by the expeditions themselves, and (2) of organizing a series of simultaneous and inter-communicated observations at points favourably situated outside the antarctic region.

Observations on Drift-ice.—Recognizing the importance of knowing the yearly variations in the extent, form, and amount of drift-ice, the Congress urgently appeals to the hydrographic and meteorological institutions of all countries whose maritime commerce traverses regions where drift-ice occurs, to institute international observations, and unify the results by communicating them to a central office. The Danish Meteorological Institute in Copenhagen is indicated as the most appropriate centre for collecting data as to ice in the northern seas. The Congress, therefore, appeals to other similar institutes, (1) to induce the masters of vessels to undertake observations on drift-ice; (2) to provide ship-masters with special forms for recording observations as supplied by the Danish Meteorological Institute; (3) to urge on the ship-masters the importance of filling up these forms and posting them at the first opportunity, either direct to Copenhagen, or through the corresponding institution in their own country.

Terminology and Nomenclature of Sub-oceanic Relief.—The Congress nominates an international committee on the nomenclature of sub-oceanic relief, charged with the preparation of a bathymetrical map of the oceans in accordance with the purpose of the committee. The map to be published not later than the meeting of the next Congress.

Uniformity in Measures.—The Congress expresses the hope that a uniform system of measures will be used in all geographical researches and discussions, and recommends that the metric system of weights and measures be so employed.

Uniformity in Thermometer Scales.—The Congress expresses the hope that in scientific publications the thermometric graduation of Celsius should be employed, or at least that the equivalents on the Celsius scale be added to the figures published according to the Fahrenheit and Réaumur systems.

Decimal Division of Time and Angles.—The Congress considers it desirable to retain the present system of the division of time, as well as that of the circle, into 360°, but admits that the possibility of a new system of dividing angles may be further studied. It offers no objection to the decimal subdivision of the degree when that appears to be useful.

International Seismological Observations.—The Congress declares itself favourable to the establishment of an international seismological society, and appoints a permanent committee for international earthquake study.

Phyto-geographical Terminology.—The Congress appoints a preliminary committee of biogeographers, resident in or near Berlin, charged with the working out on the simplest system possible of a uniform nomenclature of plant-formations, the preliminary scheme to be submitted to German and foreign specialists, and the finally corrected result to be laid before the next Congress.

Nomenclature of Oceanic Islands.—The Congress expresses the opinions, (1) that native names should be preserved even amongst the Pacific islands, where the names will have to be investigated with great care; (2) where there are no native names, or where they cannot be determined with certainty, the names given by the first discoverer should be employed until further notice; (3) the arbitrary change of historical names which have been long in use, and are universally known and accepted in scientific writings, is viewed both as impious and as confusing to science and commerce, and the practice should be opposed by every means; (4) incorrect and arbitrarily formed names ought to be discarded in favour of native names, or at least of names the use of which may be justified.

Population of Unorganized Countries.—The Congress recognizes the desirability of obtaining the data for a more exact estimate than now exists of the population of countries in which there are no means of taking a regular census, and instructs the Permanent Bureau to bring the matter to the notice of such governments as have foreign possessions, either directly or through the medium of geographical societies. In doing so attention should be drawn to the scheme proposed by Dr. Kiaer of the Norwegian Statistical Bureau, and the Permanent Bureau might also communicate with the committee on the subject appointed by the International Statistical Congress held in Christiania.

International Geographical Bibliography.—The Congress is of opinion that the *Bibliotheca Geographica*, published annually by the Berlin Geographical Society, should be accepted as realizing in a thoroughly satisfactory manner the requirements of an international bibliography of geography.

The Lost Leichhardt Expedition.—The German consul in Sydney having announced that an expedition is being organized in the Australian colonies with the sole object of seeking for the remains of Dr. Leichhardt's expedition, which was lost in the interior of Australia fifty-two years ago, the Congress, meeting in the immediate neighbourhood of the birthplace of the unfortunate explorer, takes the opportunity of expressing its sympathy with the aims of the proposed search expedition, and wishing it a successful result.

GEOGRAPHY AT THE BRITISH ASSOCIATION, DOVER, 1899.

The object of holding the meeting of the British Association this year at Dover was mainly to seize the opportunity of imparting to it a quasi-international character, by fraternizing with the French Association, which met at the same time at Boulogne. As regards the Geographical Section, the intention failed of its purpose, for no member of the French Association visited the section-room. The work of the section was heavily handicapped, and the audiences reduced far below the average of recent years, by the unfortunate situation and nature of the hall provided for its meetings. The work, however, was carried on with considerable energy, and some of the discussions were of real value.

The officials of the section were as follows :—

President: Sir John Murray, K.C.B., F.R.S. *Vice-Presidents:* Colonel G. Earl Church; Major L. Darwin, Sec. R.G.S.; Sir John Farquharson, K.C.B.; Sir Joseph Hooker, K.C.S.I.; Ll. W. Longstaff; Admiral Sir Erasmus Ommanney. *Secretaries:* H. N. Dickson and Hugh Robert Mill, D.SC. (Recorder). *Committee:* Colonel F. Bailey; J. Y. Buchanan, F.R.S.; Vaughan Cornish; H. T. Crook; Prof. R. A. Gregory; Dr. J. Scott Keltie; George R. M. Murray, F.R.S.; Staff-Com. Dubois Phillips, R.N.; B. Leigh Smith; Eli Sowerbutts; G. J. Symons, F.R.S.; Coutts Trotter.

Meetings of the section were held on five days, and twenty-six papers were read. A condensed diary of the proceedings will serve to show the character of the work submitted.

Thursday, September 14.—Sir John Murray read his presidental address, which was printed in full in the *Journal* for October.

Admiral Makaroff, of the Imperial Russian Navy, gave a most interesting account of the trial trip of the great ice-breaking steamer *Yermak*, in the polar pack north of Spitsbergen. He found that the steamer was able to make her way through ice having a thickness of as much as 14 feet, and he believed that vessels of this type had a great future before them in polar exploration. The powerful winches and derricks, with which the ship was provided, enabled large masses of ice to be turned over for the examination of the effects of water on the lower surface, and to be hoisted on deck for experiments as to the internal temperature and the effects of gradual melting.

A paper by Prof. J. Milne, F.R.S., was read, in the absence of the author, its subject being "Seismology in Relation to the Interior of the Earth."

Mr. W. S. Bruce, who had just returned from a cruise on the Prince of Monaco's yacht *Princesse Alice* to Spitsbergen, gave a short account of the oceanographical observations which he had carried out during several recent years on different parts of the Barents sea.

The eighth report of the Committee on the Climate of Tropical

Africa, drawn up by Mr. E. G. Ravenstein, was read, and the copy of observations and notes from a large number of stations was laid on the table. The report is as follows:—

Meteorological returns have reached your committee, in the course of last year, from forty stations in Africa.

Niger Territories.—One year's observations from Old Calabar have been received from Mr. E. G. Fenton, the medical officer. We regret that no information respecting the interior of the country has become available.

British Central Africa.—The scientific department, under the zealous direction of Mr. J. McClounie, is now in full working order, and full reports have been received for two stations of the second order, namely, Zomba on the highland, and Fort Johnston on the lake level, as also reports, more or less complete, from twenty-two other stations. Mr. McClounie hopes to be able, in the course of the present year, to equip two more stations of the second order, namely, Chinde on the coast, and another station on the lake. He has attempted to make two-hourly observations on term days, but as the exposure in the morning air resulted in fever, he has given up the attempt.

We have, in addition, received three years' registers for Lauderdale, from our most faithful correspondent, Mr. John W. Moir, as also fifteen months' record from Kambola, a station of the London Missionary Society, near the southern extremity of Tanganyika. The observer at the latter place is Dr. James F. Mackay.

British East Africa.—Returns from eight Government stations have been received. These returns are, of course, most welcome, and they speak well for the zeal of Mr. Craufurd and the officers working under him; but considering the practical importance of meteorological work, it is much to be desired that something more should be done. Let us hope that the satisfactory working of a "Scientific Department" in the South African Protectorate may induce the authorities to organize a similar institution for East Africa and Uganda. As a proof of the high value placed upon work of this kind in the neighbouring German Protectorate, we may state that a professional meteorologist has been appointed as inspector, and that there are now at work twenty-six stations, including two of the first and seven of the second order.

We are likewise in receipt of rainfall observations made by the Rev. R. M. Ormerod at Golbanti, on the Tana river.

The Old Scottish Missionary Station at Kibwezi has been abandoned, and the missionaries have removed to a new station in Kikuyu, whence three months' observations have already been forwarded.

Uganda.—The valuable observations on the level of the Victoria Nyanza have been resumed since the suppression of the mutiny.

Mr. C. W. Hobley has forwarded two years' record of the rainfall at Mumia's, the headquarter station at Kavirondo.

Our earth thermometer has accompanied Captain Austin during his journey to Lake Rudolf, but no record of work done has hitherto been received.

Friday, September 15.—Dr. H. R. Mill read some notes on the voyage of Sir George Newnes's polar yacht *Southern Cross* from Hobart to Cape Adare with Mr. Borchgrevinck's expedition on board.

M. Arctowski gave a short account of the voyage of the *Belgica*, and laid down the following suggestions for further antarctic exploration:—

"At the present day it is impossible to consider the land alone; the whole antarctic area exhibits phenomena which remain very imperfectly known. I refer specially to the great questions of atmospheric circulation, climate, circumpolar oceanography, and magnetic conditions. Hence antarctic expeditions must be conducted in three ways—

"1. A system of fixed stations arranged between the edge of the continent and the zone of ice. These stations should be supplied with all necessary magnetic and meteorological instruments, and continue at work simultaneously for one year at least.

"2. During the same year two polar expeditions should set out on opposite sides towards the south pole. This would involve two vessels strong enough to withstand the pack and equipped for wintering.

"3. Finally, a circumpolar expedition, planned to follow the edge of the pack right round, and specially equipped for oceanographical and zoological work. This expedition would also survey the accessible parts of the antarctic coast.

"Such a system of exploration must necessarily be the work of several nations. Weyprecht's idea should be revived and followed. Antarctic exploration must be conducted systematically, and it ought to be international. A series of circumpolar stations, where comparable and simultaneous observations are carried on, would make the results of the British and German antarctic expeditions remarkably complete, and vastly enhance their value. I should suggest the following arrangement of stations. A polygon of stations should unite South America and the antarctic lands. The path of the cyclonic storms passes to the south of Cape Horn, and—at least, during part of the year—to the north of Palmer Land. The polygon should include stations on the east and west coasts of Graham Land and one of the South Shetland islands, on South Orkney and on one of the Sandwich islands, together with stations at Cape Pillar, Cape Virgins, Cape Horn, Staten island, and the Falklands. With such a system excellent observations could be made on the cyclones, which seem to travel in the general direction of the upper winds from west to east, and to follow the outline of Alexander, Graham, and Palmer Lands. Between South America and the antarctic land there is a belt of low pressure, which seems to encircle the antarctic region where there is apparently a permanent anticyclone; but observations are wanting to determine the associated conditions of atmospheric circulation. It seems scarcely necessary to insist on the advantages which two other polygons of stations would present, one to the south of the Indian ocean, the other between New Zealand and Victoria Land. The second polygon would be formed by the islands of Prince Edward, Crozet, Kerguelen, and a station on Enderby Land. The third polygon would include the Balleny, Macquarie, and Auckland islands. This would be a particularly interesting polygon on account of its comparative proximity to the magnetic pole.

"The two vessels designed to winter in the pack should approach along the meridians of 145° W. and 35° E. Imprisoned in the pack, as the *Belgica* was, these vessels would be able to carry on oceanographical and zoological work, and also to collect magnetic and meteorological observations, thus adding two stations near the pole to the various polygons. From the meteorological point of view it would be extremely interesting for these vessels to reach high latitudes, for the region near the pole will probably differ greatly from the northern edge of the antarctic lands in everything regarding atmospheric pressure, wind, and storms.

"As to the circumpolar expeditions, I think that the vessel intended for this purpose should be quite independent of those which penetrate the pack. The region is too great to admit of the whole voyage being completed in one season—three would probably be necessary."

Mr. J. Y. Buchanan, F.R.S., gave an account of the chemical and physical work to be undertaken on an antarctic expedition. The paper is given in full in the present number of the *Journal*.

Mr. George Murray, F.R.S., spoke of the botanical work which should be undertaken on an antarctic expedition, and incidentally referred to the probable cost of ships and equipment for a scientific voyage in the far south.

A discussion on antarctic exploration followed the reading of these papers. Prof. Rücker, Secretary of the Royal Society, said that what he desired as a magnetician was not so much a series of very elaborate observations at fixed stations as a general magnetic survey round the whole region on a simple scale carried out from a wooden ship. Of course, it would be best if it were found possible to combine fixed stations and a cruising survey.

Major Darwin said that two principles ought to guide all the plans for antarctic exploration—(1) if a ship is specially built for navigating the ice-laden antarctic waters, she should spend the whole of her available time in those waters; (2) the greatest unknown factor should be attacked—this was undoubtedly the antarctic continent, the exploration of which ought to be undertaken deliberately and thoroughly.

Dr. Koettlitz, surgeon to the Jackson-Harmsworth expedition, laid stress on the absolute necessity of expert supervision in the preparation of all preserved foods for an antarctic expedition.

Dr. H. O. Forbes read the report of the committee on the exploration of Sokotra, describing his recent visit to that island.

Mrs. W. R. Rickmers gave an account of the recent journey which she made with her husband to East Bokhara, and exhibited a series of particularly fine lantern slides of the scenery of the region.

Mr. O. H. Howarth read a paper on a journey in Western Oaxaca, Mexico, an abstract of which will appear in the *Journal*.

Dr. G. Schott gave an account of the meteorology and oceanography of

the *Valdivia* expedition, the main outlines of which were published in the *Journal* for June, vol. xiii. p. 640; and he illustrated the paper by some remarkable photographs of Bouvet island and of antarctic icebergs.

Mr. H. N. Dickson discussed the temperature of the sea round the British coasts in relation to the temperature of the air.

Monday, September 18.—Sir John Murray and Mr. F. P. Pullar described the work they are engaged in on the Scottish fresh-water lakes, the systematic sounding of which they have undertaken. The sounding-machine devised by Mr. Pullar was exhibited and its action explained, and bathymetrical maps of a number of the lochs were shown.

Sir John Murray and Mr. Irvine submitted a paper, entitled "The Distribution of Nitrogen and Ammonia in Ocean Water."

Mr. H. N. Dickson described the present state of his elaborate research on the temperature and salinity of the surface-water of the North Atlantic during 1896 and 1897.

Dr. H. R. Mill put forward a tentative scheme for a terminology of the forms of suboceanic relief. He said—

"It is obvious that there are two great classes of forms, elevations above and depressions below the general level of the ocean floor; but the question is how many subdivisions of each can be recognized as distinctive and deserving of generic names. I am inclined to put forward tentatively the following general scheme of terminology, premising that no attempt be made to localize any precise type of form unless a considerable number of soundings exists to define it:—

"*Depression.*—The general term for any hollow of the ocean floor.

"*Basin.*—A relatively wide depression, with comparatively gently sloping sides.

"*Caldron.*—A relatively wide depression, with comparatively steeply sloping sides.

"*Furrow.*—A relatively narrow depression, with comparatively gently sloping sides.

"*Trough.*—A relatively narrow depression, with comparatively steeply sloping sides.

"*Wall.*—Any submarine slope comparable in steepness to a precipice on land.

"*Floor.*—Any very gentle submarine slope or nearly level surface.

"*Elevation.*—Any inequality above the general level of the ocean floor.

"*Rise.*—A relatively narrow elevation.

"*Bank.*—A relatively wide elevation.

"*Shoal.*—An elevation coming within 5 fathoms of the surface, so as to be a danger to shipping.

"*Shelf.*—A nearly horizontal bank attached to the land and bordered seaward by a much more abrupt downward slope."

Sir John Farquharson, late Director-General of the Ordnance Survey, gave a most comprehensive account of the work of the national survey during the last twelve years, which will be submitted to the Royal Geographical Society in an ampler form, accompanied by a carefully selected collection of British and foreign maps, during the current session. The work of the survey was criticized by Mr. H. T. Crook, who was replied to by Sir John Farquharson and by Colonel Johnston, the Director-General of the Survey.

Mr. Vaughan Cornish read a paper on the sand-dunes surrounding the delta of the Nile, comparing them with the small sand-dunes he had previously studied on the south coast of England, and explaining their size and grouping by reference to the direction of the prevailing wind and the distribution of moisture in the soil.

Tuesday, September 19, 1899.—Tuesday was devoted mainly to travel papers. Dr. A. C. Haddon, F.R.S., under the title of "Anthropogeographical Notes on New Guinea and Sarawak," treated some of his observations during the recent Cambridge anthropological expedition in their geographical bearings, showing how the occupations and manner of life of the primitive peoples he had been studying were direct consequences of their geographical environment.

Mr. W. R. Rickmers described his journey in the Karch-Chal mountains of Transcaucasia, a fuller account of which will be presented to the Society.

Captain Wellby gave a fascinating account of his recent journey through the borders of Abyssinia, a fuller report of which will be presented to the Royal Geographical Society.

Mr. Walter Wellman gave some notes on his unsuccessful expedition to Franz Josef Land.

Mr. C. W. Andrews read an interesting paper on Christmas island in relation to the neighbouring lands, in which he drew attention to the extraordinary biological puzzles presented by the island, not the least of which is the presence of a true earthworm, a form of life never previously detected on so remote an oceanic iceland.

A paper on the date of the discovery of Australia by Mr. E. Heawood was communicated in the absence of the author.

Almost all the papers in the course of the meetings of the section were illustrated by lantern views, and the local committee at Dover deserve special thanks for the admirable arrangements they made for the provision of a first-rate lantern and a skilful operator.

ON THE PHYSICAL AND CHEMICAL WORK OF AN ANTARCTIC EXPEDITION.*

By J. Y. BUCHANAN, F.R.S.

After the communications which have just been made to the section, there seems to remain very little to be said on the subject of the fitting out of an antarctic expedition. The problem is solved, and it is a matter for hearty congratulation that before the close of the century the British Association should have received the account of the first wintering ever effected by human beings within the antarctic circle, and the preliminary report of the successful landing and establishment of the first party to spend the winter on land within the same circle. We know how both expeditions have been fitted out, how they have been composed, and it can easily be ascertained what they cost.

The party, consisting of seven scientific men, at present wintering at Cape Adair, are placed in the distinguished position of being able to furnish the first report of the winter conditions on antarctic land by the liberality and public spirit of one man, Sir George Newnes, and nothing can prevent his being the first to furnish authentic information about this dark continent throughout a whole year. For this he deserves the thanks of the scientific world.

The communication of Dr. Arçtowski, illustrated by the very beautiful slides which he has shown to us, shows the possibility of doing good work in safety while enclosed in the southern pack. We have thus a marine antarctic expedition which has been completed and shows splendid work, and a land expedition established which cannot fail in a few months to show an equally good record. It only remains for us to follow one or other example or both.

The photographs with which Dr. Arçtowski has illustrated his paper are of great geographical interest. The pictures of the ice, and especially of the mountains and glaciers of the islands visited, show, as he has himself pointed out, a distinctly arctic *facies*, which seems to be characteristic of the region west of the meridian of Cape Horn. The icebergs are comparatively small and irregular in shape, as they are in the north, and they are in striking contrast to the enormous tabular bergs met with east of that meridian, which are always regarded as the typical antarctic form of iceberg. Further, the photographs of the mountains and the glaciers from which these bergs spring recall Spitsbergen, though they seem to be grander; and the idea immediately crossed my mind that we have here a new and inexhaustible field for the activity of the Alpine climber. The Swiss mountains are nearly played out, and nothing now is left to be done except to ascend old summits by new and more dangerous routes. In the grim solitudes photographed by Dr. Arçtowski, the successful climber will be rewarded for his hardships by the fame of the discoverer. For the student of ice, the photographs by Dr. Arçtowski are of great value, and it is to be hoped that his report will illustrate and interpret them, and that no detail will be omitted which can throw light on the physical conditions of the ice of all kinds met with by him during his sojourn on the *Belgica*.

Having borne my testimony to the scientific importance and value of the marine expedition which has returned, and by anticipation to that of the land expedition which is now at work, I find it a little difficult to say anything that will be interesting on the subject of the chemical and physical work of our antarctic expedition. The work of the chemist and physicist of a marine expedition is well

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* Paper read at the Dover meeting of the British Association, September, 1899.

known, and I do not propose to take up the time of this section by repeating it. One or two useful suggestions, however, may be made. If one of the ships fitted out by this country follows the route which I am most inclined to favour, namely, from the Falkland islands southwards, the marine work will join directly on to that of the *Challenger*. One of the striking features of the ocean discovered by that expedition was the extensive area of very cold water which occupies the bottom of the sea from the east coast of South America to the ridge which runs north and south in the meridian of the island of Ascension. Here the bottom temperature was found to be 32°·5 Fahr. The existence of this exceptionally cold bottom water was discovered on the outward voyage in soundings near the Brazilian coast, so that the expedition was prepared to take up the study of it on its way home. This was done very thoroughly on a line from the mouth of the river Plate along the parallel of 35° to the meridian of Ascension. The depth of the water varied from 1900 to 2900 fathoms, and the distribution of temperature in the water was, roughly, a warm surface layer of perhaps 100 to 200 fathoms, then a thick layer of water of temperature about 36° Fahr. down to 1600 fathoms near the coast, and to 2200 fathoms or thereabout out at sea. Here was a steep temperature-gradient falling away rapidly from 35° to 33° Fahr., and more slowly to 32°·5 Fahr. The occurrence of the steep gradient shows a renewal of the water, and therefore a current. The observations of the *Valdivia* show a similar distribution in lat. 60° to 63° S., with this difference—that the surface layer is colder than the intermediate one, which is also somewhat colder, being about 34° Fahr. The bottom layer has as low a temperature as 31°·5 Fahr. Unfortunately, there are not enough determinations of the temperature of the deeper layers to indicate the gradient which separates the cold bottom water from the comparatively warm intermediate water. The recommendation, therefore, which I would make is, that in these regions temperature observations in the deeper layers should not be spared, and where there is water of exceptional coldness at the bottom, the position and steepness of the gradient which separates it from the overlying water should be accurately determined. Further, as the whole range of temperature to be dealt with in antarctic water is at the most from 28° to 35° or 36° Fahr., and therefore small differences of temperature are relatively of great importance, it is well to have the thermometers constructed specially for this work, the scale containing few degrees, but these wide apart. In the survey of the Gulf of Guinea in the *Buccaneer*, I had such thermometers, and I regularly sounded with a thermometer at the end of the wire, and another usually 250 fathoms above it.

It is also of great importance to ascertain the density of this exceptionally cold bottom water. Near the coast of South America it was found in the *Challenger* to be very high, and this was confirmed by an observation of the *Gazelle* in the same locality. It is this density at constant temperature which decides whether a water can carry its surface temperature down to great depths, or whether it shall remain at the surface, and it is the annual range of temperature of such water which gives it its penetrating power. This was clearly set forth in a paper sent home during the first year of the voyage of the *Challenger*, and published in the *Proceedings of the Royal Society*.* The highest surface densities are found in the North Atlantic, in the Trade wind regions, and there the surface water has a higher density than any layer below it; consequently, when it is cooled in winter to the same temperature as the water immediately below it, it sinks through it, and in this way a high temperature is disseminated through the whole thickness of the water of the North

* "Note on the Vertical Distribution of Temperature in the Ocean," by J. Y. Buchanan. *Proc. R.S.*, 1874, vol. 23, p. 123.

Atlantic. In the eastern part of this ocean the density and temperature of the bottom waters are sensibly increased by the "brining down" of the Mediterranean.

The determination of the atmospheric gases dissolved in the sea-water is an important piece of routine work for the chemist when at sea, and no opportunity should be missed of extracting and analyzing them from waters of all depths. The variation in the quantity of oxygen dissolved is an indication of the extent to which the dissolved air has been used in the support of life. There are titrimetric methods for the determination of this factor, which enable the oxygen alone to be determined in many more samples of water than can be overtaken when the gases have to be boiled out and collected before being analyzed. But this operation should not be neglected, as it is only by actually extracting the gases and analyzing them that we can obtain the absolute amount of nitrogen present, and it has important bearings on the temperature, which the water, if from the bottom or from intermediate depths, had when it was exposed to the atmosphere at the surface. There are many forms of apparatus which enable this to be done satisfactorily. The apparatus used in the *Challenger*, which was communicated to me by Dr. Jacobsen when the *Pomerania* visited Leith in 1872, acts very well in competent hands. I have since improved it by using a hand air-pump, fixed to the table, to do the work of making the vacuum. The subsidiary bulb, which in the original apparatus held the water, which had to be kept boiling continuously for ten minutes in order to eliminate the air, is made vertical and like a 50 c.c. pipette. It is graduated, and when slightly warmed after exhausting with the air-pump, sufficient steam is generated to guarantee that the pump removes the last traces of air before the upper end of the gas-tube is sealed. When the operation is finished, the residual air in the subsidiary bulb can be easily and accurately measured. The addition of the air-pump makes it possible to get through a great deal more work than was possible when the vacuum had to be made by boiling water.

If the route which I have suggested be followed, the ship will come into the neighbourhood of Weddell's furthest south, in lat. 74° 20′ S., long. 33° W., and of Ross's remarkable sounding of over 4000 fathoms with no bottom in lat. 68° 30′ S. and long. 12° 30′ W. I have always regarded this sounding as authentic, because Sir James Ross was as capable of making correct soundings in deep water as any surveying captain of the present day. The numerous soundings of 3000 fathoms and over which have been made in the *Valdivia* about midway between the route of the *Challenger* and Ross's sounding, must help to convince those who have regarded Ross's sounding with suspicion. The common feature of antarctic water found by all expeditions is the thick warm layer above described, lying between a cold layer at the surface and another cold layer at the bottom. It is very important to trace these two cold layers southwards until they join, and the warm intermediate layer has disappeared. Every particular connected with this will be of interest.

Sir James Ross, in his description of his voyage, frequently refers to 39° Fahr. as the temperature of maximum density of all waters, and draws curious conclusions. Now, it was well known before the date of his voyage that average sea-water continues to contract to a much lower temperature than 39°. Indeed, its temperature of maximum density is below that of its freezing-point, which may be put at 29° Fahr. A similar mistake is often made at the present day by geographical writers. Although everybody knows and recognizes that sea-water freezes at a temperature below that of fresh water, and that this temperature is the lower the greater the quantity of salt contained in the sea-water, it is to

some extent not known and to a great extent not recognized that pure ice, which when left to itself melts at 32° Fahr., begins to melt in salt water at exactly the same temperature as that at which the same water begins to freeze. A piece of pure lake-ice immersed in average sea-water reduces its own temperature and that of the sea-water in its immediate neighbourhood to a temperature of roughly 29° Fahr., which varies with the concentration of the resultant brine formed by the mixture of the sea-water with the pure water formed by the melting of the ice. An iceberg consists of pure land-ice, and if it is of sufficient thickness to reach the layer of warm intermediate water, its lower surface must be always melting at a temperature of about 29° Fahr., and this temperature must in time be communicated to the body of the ice if it did not have it before. But it must necessarily be at about this temperature, because it separates from the parent land-ice after it has been pushed into the sea. If it had a temperature below 29° Fahr., it would freeze the sea-water round it until it had got rid of its excessive cold; and if it had a temperature above 29° Fahr., the sea-water round it would melt its ice until it had got rid of its excessive heat. 29° Fahr. is taken as the representative freezing temperature of sea-water, but it varies with the salinity. In this respect sea-water was found to agree closely with a solution of chloride of sodium containing the same percentage of chlorine. The subject was carefully investigated during the winter 1886–87, and the results were communicated to the Royal Society of Edinburgh, in a paper which was read on March 21, 1887.* The rule regulating the appearance or disappearance of ice in a solution of chloride of sodium is very simple. The number expressing the percentage by weight of chlorine in the solution expresses on Celsius' scale the depression of the freezing-point of the solution below that of distilled water, and by consequence the temperature at which pure ice begins to melt in the same solution. Thus the freezing-point of a solution of chloride of sodium containing 1 per cent. of chlorine is −1°·0 C.; if it contains 1·75 per cent. chlorine, its freezing-point is −1°·75 C.; and so on for concentrations not exceeding that of the saltest ocean water. Sea-water, the solid contents of which consist chiefly of chlorides, follows this rule approximately, but not exactly. The following table, from p. 133 of the memoir, is derived from twenty-five determinations made with the greatest care in sea-waters of different degrees of concentration and freezing at temperatures between −0·5° C. and −2°·22 C. :—

Freezing temperature	−2°·0 C.	−1°·5 C.	−1°·0 C.	−0°·5 C.
Per cent. by weight of chlorine ...	1·940	1·445	0·963	0·475
Difference	0·060	0·055	0·037	0·025

From this we have the following approximate rule: the number expressing on Celsius' scale the depression of the freezing-point of a sea-water below that of distilled water is found by adding 0·04 to the number expressing the percentage by weight of chlorine in the same water. From these few remarks, it will be seen that the mutual interaction between ice, salt, and water must be taken into account in interpreting the results of the sea-temperatures of the antarctic.

If ice is an important feature of the sea in antarctic regions, it is a still more important feature of the land, and it should be the object of careful observation by the landing-party. In the short time at his disposal, Dr. Arctowski has not been able to tell us much about its structure or other particulars, but we may confidently look forward to the detailed report of his work in the *Belgica* for much

* "On Ice and Brines," by J. Y. Buchanan (1887). *Proc. R.S.E.*, vol. xiv. p. 129; also *Nature* (1887), vol. xxxv. pp. 516, 608, and vol. xxxvi. p. 9.

that cannot fail to interest the student of ice. The subject is a large one. The longer one studies ice the more one finds there is to learn about it, and the physicist or chemist who takes part in the expedition should miss no opportunity of studying it in all directions. In order to do so with effect, he ought to have made preliminary studies of glaciers in Switzerland, where he finds every facility to his hand, and these studies should be made in winter as well as in summer. It is of little use to send a man to study the peculiarities of antarctic ice if he has not made himself acquainted with all that is to be learned about European ice. The time of the expedition should not be wasted in learning elementary matters. I felt this myself when the *Challenger* was in antarctic waters. I had been in Switzerland; I had been on glaciers and in glaciers; I was familiar with the literature about pressure and fusion and regelation, but it was all of no use when the ice, which was brought down from a large berg by a shot, was brought on board: I had never studied ice, and could form no opinion whether it was the same as Swiss glacier ice, or, if it was different, how it differed; and there was nobody on board who knew any more than I did.

Another educational preliminary for the members of a land expedition is to acquire as much skill as possible in ski running and the method of travel adopted by Nansen in crossing Greenland. For this purpose a short visit to Norway in winter would be useful. The way into the interior will almost certainly be over land ice, and if it is the ice which is the parent of the great tabular bergs so well known from illustrations, it is probable that travelling over it will not be very difficult in so far as the nature of its surface is concerned. It is probable that landing will only be effected in localities like Cape Adare, where a shoulder comes out from the main mountain ridge and reaches the sea, forming a promontory. From want of support seaward the land ice falls away on either side from the ridge, or *arrête*, leaving the rock bare except for fresh snow. Such a bare ridge will afford the indispensable fixed foundation for observations on the motion of the neighbouring glacier, and means should be taken to set lines of stones or other marks and fix their position before the darkness of winter sets in. It has long been known that the glaciers of Greenland travel much more rapidly than those of Switzerland, but it is only since the publication of * v. Drygalski's remarkable observations, carried on throughout the year on the glaciers of the west coast of Greenland, that we know that in some cases the motion of the ice reaches the astonishing rate of 18 metres in twenty-four hours, and that this rate of motion is very little affected by the change of season. According to Drygalski, what chiefly affects the motion of a glacier is its mass. Great as are the glaciers of Greenland, there can be little doubt that the parents of the antarctic tabular icebergs are many times greater, and it is not inconceivable that at this moment Sir George Newnes' observers may be enjoying the extraordinary spectacle of a glacier advancing as visibly as the stream of a sluggish river. If conditions such as these exist on the antarctic land, it is little wonder that the supply of tabular icebergs is so abundant, and we get a new light on the amount of precipitation within the antarctic circle. Dr. Arctowski has described how, on the occasions when he landed on the rugged coasts visited by the *Belgica*, and the weather was calm, the thunder of falling ice was continuous. On Heard island, during the short visit which I was able to pay it from the *Challenger*, the fall of ice from the western portion was also nearly continuous.

Since the days of Hugi and Agassiz, the intimate structure of glacier ice has been the object of much study by continental and chiefly Swiss naturalists.

* 'Grönland Expedition, 1891–1893, unter Leitung von Erich von Drygalski.' Berlin, 1897.

Englishmen, though they frequent glaciers as much as any other nation, have generally ignored it. Tyndall, to whom we owe so much of our knowledge about ice, recognized the existence of the *grain* of the glacier, as it is called, but made no use of it in his speculations with regard to the nature of the motion of glaciers. As his theories are independent of this fundamental feature of the constitution of glacier ice, they must be *pro tanto* incomplete. The colour of the surface of a glacier, so dazzling in its whiteness that the inexperienced beholder is apt to suppose it covered with freshly fallen snow, is due to the disintegration of the compact blue glacier ice into its constituent grains under the influence of the radiation of the sun. There is no more instructive or more beautiful experiment than to expose a block of compact blue ice taken from the interior of the glacier to the direct rays of a powerful sun. Such a block is easily obtained by penetrating into the grotto from which the glacier stream issues to such a distance that direct sky-light is shut out. Any of the blocks found there will do, and it is to be brought out and exposed on a rock. In twenty minutes or half an hour the block falls down into a heap of irregularly shaped pieces of ice, each of which is a grain and a single crystalline individual. In higher latitudes or in dull weather, the power of the sun is not sufficiently strong to effect this complete and striking dissolution, but it loosens the block into its grains, which will rattle if the block be shaken.

I have analyzed blocks of ice from many Swiss glaciers, and weighed the individual grains. They are of all weights up to a certain maximum, which varies with the glacier and the part of it furnishing the ice. The largest that I have met with was from the Aletsch glacier, and it weighed 700 grams. It is the size or weight of the largest grains that it is important to determine. Small grains are abundant in every glacier, and are a necessity in order that the larger ones may pack close. The size of the largest grains is what is referred to when we read that the grain of this glacier is large or of that one small. The shape of the grain is irregular, and no two of them are alike, but they fit into each other like a puzzle. They resemble a collection of vertebræ more than anything else. Indeed, if the disarticulated vertebræ of an animal, especially one with a long tail, were carefully packed into a box of a suitable size, so as to occupy the least possible space, the boxful of vertebræ would resemble the block of ice which has been loosened by a moderate sun, and would rattle when shaken in much the same way. If gelatine were allowed to run into the box and set, we should have a model of the block of ice before exposure to the sun. If the box of vertebræ were exposed to the sun, the gelatine would be liquefied, and the mass would be loosened as in the case of the ice. What is it in the block of ice which corresponds to the gelatine in our illustration with the vertebræ? It is the slightly impure water which surrounds the grains and in which they *float* or try to float. Under the influence of cold this impure water supplies pure ice to the grain with which it is in contact, while its freezing-point continually falls; finally its freezing-point and the temperature to which it is exposed reach a minimum, and the grain remains in contact, even in mid-winter, with a film of brine, which may be very minute. With rising temperature the grain begins to melt at the temperature at which it ceased to freeze, it dilutes the brine, and raises its own melting-point. We see, then, that the grain of the glacier may be surrounded in summer by a relatively considerable envelope of water of comparative purity and high freezing-point, while in winter it is surrounded by a mere film of brine of comparatively low freezing-point.

A ship floats in the smallest basin as perfectly as in the largest ocean. We can imagine a dock being built round a ship, and so exactly moulded to its shape, that between the inner surface of the dock and the outer surface of the ship the clearance

shall be so small that a pitcher of water poured into it will float the ship. The floating of a grain in the inside of a glacier is of this kind, and as it is enclosed on all sides, it will press against the ice above it in preference to that beneath it.

This feature of glacier ice permits us to understand how glaciers can move and begin to move even when their temperature is very low. Before von Drygalski's work on Greenland, we had no trustworthy information regarding the temperature throughout the year of the inner mass of the ice of any glacier. He carried out, at regular intervals of time, a series of observations of the temperature at different depths below the surface of one of the Greenland glaciers, and parallel observations within the ice covering a neighbouring lake. These observations showed that the temperature of the glacier increases rapidly from the surface downward, and they render it probable that the greater part of the thickness of a Greenland glacier is, even at the coldest time of the year, at or near the ordinary temperature of melting ice.* The heat required to support this temperature can only be supplied by the friction of the grains of the ice, called into being by the motion of the glacier. The *inland ice* which forms the great reservoir for the supply of the glacier, was found to have little or no appreciable motion. Series of temperatures were not taken in its thickness, but, in the absence of motion, we may believe that the very low temperature at its surface penetrates far into its interior, if not to the very bottom. If the motion were dependent only on the lowering effect of pressure on the melting-point of pure ice, it would be difficult for such a mass of ice to *start* when it arrives at an outlet. The impurity of all natural water and the effect which it has in lowering the melting point of ice at ordinary pressures remove this difficulty. However compact and solid the blue ice may look, there will always be *some* brine between its grains which will permit some yielding of its mass, which in its turn will produce a first generation of heat; this will produce a further yielding, and in due course a further generation of heat, and the effect of this initial agency, when combined with the powerful effect of fusion and regelation under conditions of very slight variation of temperature, is the extraordinary rate of motion observed in the glaciers of Greenland.

Drygalski is to be the leader of the German Antarctic Expedition, and we may be sure that he will continue the researches which he has begun so successfully in the arctic regions. Parallel observations should be made by the English observers on the land-ice with which they meet, and they will, as a matter of course, have made themselves familiar with what has been done already in this department.

It has been pointed out that the whiteness of the surface of a glacier is due to what may correctly be termed sun-burning or sun weathering. The icebergs which are met with at sea have an equally white surface, but where the interior is exposed either in crevasses or in caves worn by the waves, the deep blue colour of the fresh ice is visible. It is obvious that the whole of the surface of the glacier which is immersed in water at greater depth than that to which the sun's rays can penetrate must have the same blue colour, and it is equally obvious that when an iceberg turns completely over, it must stand out as an intensely deep blue mountain of ice among the multitude of sunburnt white ones. On one of the very fine days during the sojourn of the *Challenger* in antarctic waters, a striking and magnificent example of this was observed, but the cause of the blueness of the strange berg was quite unsuspected. If ice were collected, by bombardment or otherwise, from such a berg, the grain would be large and well developed, and the ice would be quite compact and free from vesicles. In the region visited by Dr. Arctowski, the glaciers

* Compare Hugi, 'Ueber das Wesen der Gletscher und Winterreise in das Eismeer,' p. 51.

and the icebergs were comparatively small and of an arctic character. The distribution of snow, *névé*, and ice he describes as being similar to that in the Alps at a height of 3000 to 4000 metres. There appeared to be very little melting, yet the glaciers advanced steadily towards the sea. In the *Challenger* I observed at least one large tabular berg which was melting freely on the top, and streams cascading down the sides. In Spitsbergen the glacier streams often take large proportions; it will be interesting to know if in equally high southern latitudes there is similar melting under the influence of the long polar day.

It was my intention to say something about the meteorology of the antarctic, but when I read the account by Sir George Newnes of the blizzard which greeted his party on landing at Cape Adare, I felt that it would be pure guessing. A temperature of −18° Fahr. with a furious tempest of wind in the middle of what corresponds to our month of August, is a fact which disables prophecy. Let us hope that the winter climate will contrast less unfavourably with that in the arctic than the summer does.

It is the intention to establish observing-stations on some of the islands of the southern ocean. It is particularly to be desired that a pair of stations should be established, one near the south end of Kerguelen, in Royal sound for instance, and the other on Heard island. Kerguelen is completely in the south temperate zone, and Heard island is completely in the antarctic zone, and is glaciated from summit to sea-level, and they are only 180 miles apart.

I have nothing further to say about the work of a physicist and chemist on an antarctic expedition. He will be selected for his efficiency, and he must keep his science and his art handy for use when occasion may arise.

THE OXFORD SCHOOL OF GEOGRAPHY.

Some information concerning the Oxford School of Geography was given in the July number of the *Journal*. The following is a more detailed statement of the programme issued by the Committee:—

Staff.—Reader in Geography: H. J. Mackinder, M.A., student of Christ Church.

Assistant to the Reader: Andrew J. Herbertson, PH.D.

Lecturer in Physical Geography: H. N. Dickson, F.R.S.E., New College.

Lecturer on Ancient Geography for 1899–1900: G. B. Grundy, M.A., Brasenose College.

Courses of Study.—The Committee have under consideration a comprehensive scheme of theoretical and practical instruction in Geography, the details of which will be published during the Michaelmas Term. The full course will probably extend over one academic year.

The following arrangements have been made for the Michaelmas Term. The lectures and practical instruction during this term will form part of the complete course for the first year.

The Reader in Geography (Mr. Mackinder) will lecture twice weekly on "The Historical Geography of the British Isles," commencing in the first week of November.

The Lecturer in Physical Geography (Mr. Dickson) will lecture twice weekly on "The Climate of the British Isles," on Mondays and Thursdays, at 11 a.m.

The Assistant to the Reader (Dr. Herbertson) will lecture once a week on "The Geomorphology of Europe," on Tuesdays, at 11 a.m.

The Lecturer in Ancient Geography (Mr. Grundy) will lecture once a week on "The General Historical Topography of Greece," on Fridays, at 5.30 p.m.

The laboratory will be open daily (except Saturdays) from 10 to 4. The Assistant to the Reader will give instruction in cartography and practical geography, with field work: during the Michaelmas Term special attention will be given to the study of map projections, and of physical maps of all kinds. At least one hour a week will be devoted to the discussion of recent geographical literature.

The lecture-room and laboratory are on the upper floor of the Old Ashmolean Museum, Broad Street.

Fees.—Members of the University free to lectures; £2 a term for Reader's class, £3 a term for Assistant's classes.

Persons not members of the University, 10s. for each course of lectures, in addition to the above class fees; for full course, £21 a year.

All communications with reference to the school should be addressed to H. J. Mackinder, Esq., Department of Geography, Old Ashmolean Museum, Broad Street, Oxford.

THE MONTHLY RECORD.

ASIA.

Central Asian History.*—In a compact volume suited to the requirements of the general reader, and equally useful as an introduction to more serious study, the authors of 'The Heart of Asia' have supplied, "for the first time in any language," to quote the words of the preface, "a consecutive history of Central Asian events from the earliest days." Considering the importance of the events of which that region has been the theatre of late years, and the practical certainty, that its future will exercise no less important influence on the history of the continent, it is alike matter of surprise that the want should not have been already supplied, and of satisfaction that this should at last have been done. The authors are qualified for the task both by personal acquaintance with the country with which they deal, and—in the case of Prof. Ross, who is principally responsible for the purely historical chapters—by a knowledge of the languages of the original authorities (Persian, Arabic, and Russian), which are utterly inaccessible to the ordinary reader. The first half of the book traces the varying fortunes of Central Asia (or rather that part of it lying between the Caspian, the Sir Darya, and the Hindu-kush) under Eastern rulers, from the early days when it formed a satrapy of the Persian empire under Darius II., to the commencement of the final struggle with Russia in the days of Mozaffar-ud-Din of Bokhara. This history of changing dynasties, while dealing with some familiar names, such as those of Chinghiz-Khan and Timur, is for the most part entirely new ground to the English reader, though others of the actors on the stage—notably the Arab leader, Kutayba ibn Muslim—deserve to be better known than they have been. Kutayba's career of conquest commenced with his triumphal entry into Merv,† as governor of Khorasan, in A.D. 705. The second half of the book is perhaps the most valuable, as chronicling the steady advance of Russia in Central Asia, and giving a clear insight into the causes of her success. The concluding chapter, in which the mutual relations of Russia and Great Britain are discussed, merits careful attention. The authors show a high appreciation of the value of the work accomplished by the Russians,

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* 'The Heart of Asia.' By Francis Henry Skrine and Edward Denison Ross. London: Methuen. 1899.

† The epithet by which this city was distinguished from its less important namesake, has, it seems, been wrongly translated "Queen of the World."

who, in spite of some faults, are, they say, "a young and vigorous race, imbued with a passionate love of their country, a steadfast belief in its high destinies, both rare and precious in these days of flabby cosmopolitanism."

Lieut. Olufsen's Expedition to the Pamirs.—We learn from the *Geographische Zeitschrift* (1899, p. 410) that the Danish expedition (*Journal*, vol xiii. p. 302) left its winter quarters at Shorok on March 1, and proceeded southwards to explore the upper valleys of the Hindu-kush in that direction. It was proposed subsequently to traverse Wakhan towards the north-east, and proceed to Kashgar. Great difficulties had been experienced in obtaining porters and beasts of burden. During the winter the greater part of the Pamirs, apart from the high passes, remained free from snow. The approach of spring was announced by a severe storm towards the end of February.

Korea.—From the 'Report on the Trade and Commerce of Corea for the year 1898,' by Mr. J. N. Jordan (Foreign Office, Annual No. 2304, 1899), we note the following particulars. The two ports of Chinnampo and Mokpo that were opened on October 1, 1897, have developed a very satisfactory import trade. The trade of both these places is still carried on to a large extent through the older ports of Fusan and Chemulpo. Mokpo, from its central position, will probably in a few years become a place of considerable commercial importance. It lies about 7 miles from the mouth of the Keum Sang river, on the south-west coast of Korea, and forms the outlet for the produce of the three richest provinces in the peninsula. The ports of Song Chin, Kunsan, and Masanpo, and the city of Pingyang were to be opened on May 1 of the present year. Pingyang is the city of which Chinnampo forms the treaty port, and lies 40 miles further up the river. Of the three new treaty ports Kunsan is pointed out as the most promising. Situated in lat. 36° and long. 126° 43′, it lies a little more than halfway between Chemulpo and Mokpo, near the mouth of a river, which drains a rich rice-growing section of the country. This river is navigable for large vessels as far as Kanggenmi, 30 miles distant from Kunsan, while smaller crafts can ascend as far as Kung Ju, some 30 miles further up, and the capital of the adjacent province. Kunsan possesses an indifferent harbour. Masanpo, which lies about 40 miles west of Fusan, at the mouth of the Naktong river, has the advantage of inland navigation and a superior harbour to that of Fusan. Songchin, the port of Kil-chu, is situated approximately in lat. 41° and long. 129° 20′, in the extreme northern province which adjoins Russian territory. A considerable trade in cattle and piece-goods is said to be carried on between it and Vladivostock. The Sŏul-Chemulpo railway, the construction of which was commenced in the spring of 1897, will probably not be completed before the end of 1899. A contract has been signed for the construction of a railway between Sŏul and Fusan, a distance of about 300 miles, and steps are being taken to conduct the preliminary surveys. The inter-port traffic continues to grow yearly, and is likely to develop rapidly now that there is a prospect of the whole coast-line of the peninsula being rendered accessible to steam-navigation.

AFRICA.

Mr. Weatherley's Surveys in the Bangweulu Region.—We have received from Mr. Weatherley a detailed account of his latest expedition to Bangweulu, to which brief allusion was made in a previous number. The journey appears to have entailed great hardships, as Mr. Weatherley was suffering from dysentery during much of his surveying work in the marshes bordering on the lake, and it says much for his energy and determination that he persevered in his task under the circumstances. From Chita, on Lake Mweru, Mr. Weatherley proceeded south down the plateau, and, descending into the plain, made his way to the Johnston falls on the

Luapula, and thence to the north-west corner of Bangweulu. Some 10 miles north-west of the lake three considerable rivers, the Mwampanda, Lifubu, and Liposori, unite to form a vast marsh, called Kasamba, traversed during the rainy season by narrow waterways extending to the open water of the lake. The three rivers appear to enter the latter by a single waterway named Sanga. Mr. Weatherley's observations place the north end of Bangweulu in 10° 48′ 4″ S., and the exit of the Luapula at Panta point in 11° 31′ 32″ S., thus giving it a length of 43½ miles. After visiting his old camp in 1° 19′ 50″ S., he surveyed round the islands of Kirui, Kisi, and Mbawala, and measured the breadth of the channels between them. That between the last two he found to be 4 miles 1672 yards, with a depth in the centre of 15 feet, and between Kirui and Kisi 3 miles 891 yards, with a depth of 12 feet 6 inches. From Kirui he traversed the marshes *viâ* Kokoto to Nsombo, and, crossing the Ifunge peninsula (such, and not an isthmus, he now considers it), reached the lakelet Chifunawuli, which at its south end is 5400 yards across. Regaining Bangweulu, he made for the Luapula, which was reached after an anxious time, owing to the helplessness of the canoe-men. Had not the lake remained calm many men must have been lost. Gales had on this expedition been of almost daily occurrence, whereas on the former journey the water was invariably unruffled. Near Panta point the great Kavangama marsh was crossed by shallow waterways, the canoes often sticking fast in the foul deposit of decomposed vegetation, 8 to 10 feet deep. On the Luapula the difficulties increased. The *Vigilant* and canoes were dragged across the densely wooded peninsula of Kapata, which separates the Luapula from Lake Kampolombo, but in spite of all precautions two of the canoes were stolen during the following night. Kampolombo having been surveyed, the expedition recrossed to the Luapula, which was followed down for a day through an interminable papyrus marsh. After a night spent on a quaking platform of papyrus stems, further progress was found to be impossible, the river being absolutely blocked by "sudd." The current was so sluggish as to be almost imperceptible. Returning northwards, after a vain attempt to force a way west to the Kangwena lakelet, the party returned to Kampolombo. Kangwena is a round sheet of water of no great size, connected with Kampolombo by a channel called Wutuwu (or Utuwu). While crossing Kampolombo (3¼ to 4 miles across) by the light of a young and watery moon, a furious storm of wind and hail arose; but the canoes all weathered it in safety, and camp was pitched on the east side of a peninsula which separates Kampolombo from Chifungwe, a narrow sheet of water abreast of the northern half of the Kampolombo. The next day the *Vigilant* was capsized by a hippopotamus, which, attacking from below, drove its tusks three times through the metal of the boat. This was patched up with old biscuit-tins, while rifles, sextant, camera, etc., were taken to pieces, cleaned and dried, but the watches and photographic films were ruined. Regarding Mr. Crawford's statement that he saw Bangweulu stretching away to the north from the south-west corner of Kampolombo, Mr. Weatherley says he might have done so by travelling 20 miles north, but not otherwise. Even on the very shore of the larger lake, north of Kampolombo, its water is invisible on account of the intervening Kavangama marsh. From Kampolombo the expedition struck overland for the Luapula, the canoes being abandoned and the *Vigilant* taken into sections. From Kafufwe, 112° 8′ 52″ S., Mr. Weatherley made a trip to Chitambo, and then began the voyage down the Luapula, following every bend (either by water or on the bank) until Mweru was reached. He was much impressed by the Mumbotuta falls, which, he says, no white man, not even Giraud, had visited. They are due to a great fault cutting the river diagonally, and the mad chaos of the foaming water—the thunder of which can be heard 8 or 9 miles on a still night—is an indescribably grand sight.

Beyond this, torrents of rain were experienced, food was scarce, and the party were occasionally shot at by the natives, but, by preserving an imperturbable demeanour and refusing to fire in return, always got through unharmed. The greater part of the Luapula above the Johnston falls is quite unnavigable for craft of any size—near Bangweulu on account of the sandbanks, and further north by reason of its shallowness and rapidity. At the narrow parts (about 250 yards) high-water mark was about 12 feet above low-water level, but where the stream widened to 600, 800, or 1200 yards, was proportionately lower. The whole country west from the Mwyangashe to about 10° 18′ S. is called Ukanda. Mr. Weatherley ascended several tributaries of the Luapula, proceeding up the Luombwa, partly on foot, to within two days of the Irumi mountains, which are, he thinks, placed too far from the Luapula in maps. The Mwyangashe is quite unnavigable, and flows through a deserted forest country, whence the travellers were driven back by myriads of horse-flies and tsetse. Four dogs which accompanied them sickened and died a few days later. The Johnston falls, a succession of rapids and cataracts known to the natives as Mambilima, extend from 10° 46′ to 10° 33′ S. The most southern point of Mweru is placed by Mr. Weatherley in 9° 31′ 7″ S., but the Luapula entrance is some miles further north. The northern shore of the lake, from the Belgian station at the Luapula exit to Chienye, was found by rope-measurement to be 32,950 yards (almost 19 miles). With regard to his paper published in the *Journal* last year, Mr. Weatherley states that the illustrations have accidentally been mis-named. That described, *e.g.*, as "Lake Bangweolo" is really a view of the Luapula, and "Johnston falls" should be falls of the Ruirwa near Chita. He insists that Bangweulu is the only correct spelling of the name, which has nothing to do with Pa Mwelu, while the form Bangweolo is utterly unknown to the natives on the spot.

Books and Maps on South Africa.—In view of the present events in South Africa, attention may be called to some of the books and maps which may be found of use in the study of that country and its history. The choice has to be made in a wide field, but perhaps the book giving the most thoughtful and unbiassed account of South Africa as a whole, with especial regard to the inter-relations of the country and people, is Mr. Bryce's 'Impressions of South Africa,' published in 1897. Other general works which will be found useful, both from an historical and geographical point of view, are Mr. Lucas' 'Historical Geography of the British Colonies' (vol. iv.), and works of a somewhat similar scope by the Rev. W. P. Greswell. The standard authority on South African history is, of course, that of Dr. Theal, though its bulk may prove a deterrent to the general reader. Mr. Selous's well-known works give a vivid impression of life in the wilder parts of the country, while Prof. Wallace's 'Farming Industries of Cape Colony' (1896) contains some clearly written chapters on the general surface features of the country, including parts of the Transvaal, and the excellent maps by Bartholomew are a specially useful feature. A large amount of statistical and general information is to be obtained from Noble's 'Official Handbook of the Cape and South Africa,' and in the 'Guide to South Africa' by A. Samler Brown. A large number of books dealing chiefly with political questions have appeared of late years, such as Mr. W. B. Worsfold's 'South Africa,' and Captain Younghusband's 'South Africa of To-day.' Of books dealing specially with the Transvaal, 'A Naturalist in the Transvaal,' by W. L. Distant (1892), and, among various works dealing with the gold districts, those of Messrs. Hatch & Chalmers ('The Gold-mines of the Rand,' 1895) may be mentioned. For Natal we have Mr. Russell's 'Natal, the Land and its Story' (5th edit., 1897). Of general maps of South Africa, perhaps the most useful is Bartholomew's 'Tourist's Map of South Africa,' with contours of altitude shown by five shades of colour. Messrs. W. &

A. K. Johnston also issue a clear general map, while the Transvaal, with adjacent parts of the Orange Free State, etc., is shown in map No. 1159, published by the Intelligence Division, and also in a large-scale map published this year by Stanford. Natal is shown in four large sheets, drawn in the office of the Superintendent Inspector of Schools, 1893, and published in England by Stanford; but this, though the most authoritative map of the colony, is too cumbersome for general use. Revised editions of some of these maps will no doubt be soon published. Other maps to refer to are Juta's 'Enlarged Map of South Africa from the Cape to the Zambesi,' 1891, 30 miles to an inch (E. Stanford); 'Map of Bechuanaland,' from surveys made under the direction of Major-General Sir Charles Warren, G.C.M.G., R.E., 14 sheets, 2 miles to an inch, Intelligence Division, War Office, 1886; Troye's 'Map of the Transvaal,' revised edition, 1896, 6 sheets, 8 miles to an inch (E. Stanford, London); large-scale maps of certain districts of the Cape Colony, specially in the neighbourhood of Cape Town, have been issued by the Surveyor-General's Office, Cape Town. The Orange Free State Government have large-scale maps of their country, but it is impossible to obtain anything but reductions of these. Others are Stanford's new map of the Orange Free State, the southern part of the South African Republic, the northern frontier of Cape Colony, Natal, etc., 16 miles to an inch. Philips' 'Large-scale Military Map of the Seat of War, on the Natal Frontier,' 5 miles to an inch.

The Expedition to Mount Kenya.—A telegram was received from Mr. Mackinder early in October, announcing that the expedition to Mount Kenya, in which he took part, had returned successful as to its principal object. The mountain is said to have been reached by way of Meranga (? Marange, a district of Kikuyu), while the return was over the Settima range. The summit was reached at the third attempt, and proved (according to telegraphic accounts) to be over 17,000 feet in altitude, Dr. Gregory's estimate having given it a height of about 19,000 feet. Fifteen glaciers were discovered, two of them of large size.

Journey in Marocco.—We learn from the *Comptes Rendus* of the Paris Geographical Society that Dr. F. Weisgerber has lately made a journey through the interior of Marocco, during which he surveyed some new routes and visited places rarely or never visited by Europeans. During a stay at Fez he executed a detailed survey of the city, and his plan of it is reproduced in the French periodical, together with a minute description both of the city itself and of the Wed Fez, which traverses it.

The Position of Adis Ababa.—According to a note in the *Comptes Rendus* of the Paris Geographical Society (1899, p. 264), the position of the present capital of Abyssinia was fixed astronomically, during the visit of the Marchand mission, by Captain Germain and Sub-Lieut. Dyé, the observations placing the palace of Menelik in lat. 9° 4′ N., long. 38° 42′ 50″ east of Greenwich, and the church near the great market in 9° 1′ 49″ N., 38° 42′ 2″ E. The latitudes were obtained by circummeridian altitudes of stars, culminating north and south, the longitudes by equal altitudes of the sun (for local time), and by occultations of the stars ζ Cancris and o Leonis. The results involve a considerable shifting of the position as given on the best maps. The Italian map by Captain Chaurand gives, *e.g.*, the position as in 8° 57′·5 N., 38° 56′ E., which is to be compared with the former of the above values.

The French Niger Railway.—A loan is shortly to be raised by the colony of French Guinea for the execution of the railway from Konakri to the Niger, which has been under discussion for the past few years. The original surveys were executed by Captain Salesse (*Journal*, vol. ix. p. 327), and the route will, it is said,

follow in the main the line laid down by him, though some modifications have been introduced as a result of recent surveys by M. Naudé. This scheme is, of course, quite independent of the Senegal-Niger railway.

The Development of the Cameroons.—Recent numbers of the *Deutsches Kolonialblatt* contains various items of interest respecting German activity in the Cameroons. An important step towards the extension of German influence and trade towards Lake Chad has been the expedition lately undertaken against the Sultan of Tibati, who had for some time been giving trouble to the interior stations. Captain von Kamptz, who commanded the expedition, proceeded first (February, 1899) against Tibati, the old capital of Southern Adamawa, which was reached after a difficult march by way of Yoko. The town was carried by storm in the absence of the sultan or lamido, Mohamed Amalama, who had for eleven years been investing the important town of Ngambe, chief centre of the populous district of Mandiongolo. After the fall of Tibati, where a large store of ivory fell into the hands of the victors, negotiations were opened with the Sultan of Ngaundere, who agreed to the opening of a trade route to his town by way of Yoko and Dengdeng, also placing all the Fulla states, over which he exercises an influence, under German protection. By this means the whole of South Adamawa has become subject to the Cameroons government, while the extension of German influence to Lake Chad is said to be now a matter of no difficulty. The British victories in the Sudan, which are well known in Adamawa, have contributed materially to this result. At present British products only are seen in the country, but a great impetus will no doubt now be given to German trade. On proceeding to Ngambe, Captain Kamptz found that the hostile sultan had fled, and the native chief placed himself unreservedly in the hands of the German officer. Later news states that the Sultan of Tibati has since asked for peace. The trade of the Cameroons showed a great increase during 1898, rising, as compared with 1897, from 9,712,000 to 13,898,000 marks, while the previous six years had shown a comparatively small increase. Good progress has been made with the road from Victoria to Buea, which is expected to be open for traffic throughout by January 1 next. It is proposed to extend the road northwards, in time, to Johann Albrechts-Höh, and also to construct another from Victoria to the Mungo district.

The Lower Congo.—We learn from the *Mouvement Géographique* that the railway now under construction on the north side of the lower Congo, which is intended to connect Boma with the Mayumba district and the Shiloango river, has already reached the 25th kilometre, although the first rail was not laid before March last. The total length of the line will be about 200 kilometres (125 miles). The same journal announces that an excellent map of the whole lower Congo region, from the ocean to Stanley Pool, has been prepared by M. H. Droogmans on the large scale of 1 : 100,000. It is in fifteen sheets, but these have also been combined to form a general map on the scale of 1 : 500,000. Many modifications have been introduced as regards the hydrography, and the mapping of the whole territory north of the river has been rectified. The section including the Mayumbe district is reproduced in the *Mouvement Géographique* (No. 39), to show the line of the railway above mentioned. A new survey of the Congo estuary has been in course of execution since July last by the British Admiralty.

M. Fourneau's Expedition in French Congo.—Further details respecting this expedition (*ante*, p. 319) are given in the *Bulletin du Comité de l'Afrique Française* for August. Leaving Wesso, on the upper Sanga, on February 14, 1899, the expedition at first crossed a difficult and swampy district with few inhabitants, but abounding in elephants. The Mambili, an affluent of the Mossaka, was reached on March 4, and two days later the ground became higher, but the route

led through an uninhabited wilderness where no food could be procured. At length, however, the scouts discovered a village of the Bakotas, an important tribe reaching to the right bank of the Ivindo. The districts traversed hitherto were rich in rubber vines and trees. Passing many Bakota villages, some several miles in length, the Mossaka basin was left and that of the Ivindo entered, the water-parting between the Congo and Ogowé systems being almost imperceptible. Turning north in the direction of Iloku (reached by J. de Brazza), and soon afterwards resuming a more westerly course, the expedition reached the Abombe, on April 2, having previously passed the head streams of the Jadie, which flows more to the north. On the 19th two columns were formed, M. Fondère descending the Ivindo to the Ogowé, while M. Fourneau maintained a westerly course. The Ivindo proved to be unnavigable in its lower course, although, according to M. Fondère, it deserves to be considered as the upper course of the Ogowé, containing more water than the other branch. The two sections were united once more on the banks of the Niona, and then proceeded west through the Pahuin country as far as the Bokowe. M. Fondère then descended by river to Libreville, while M. Fourneau chose a land route, and struck the coast at the Maga creek, reaching the Gabun on June 10. M. Fourneau reports in favour of the establishment of a route for rapid transit either from the Gabun to the Sanga by the valley of the Jadie, or from the Gabun to the Mossaka by that of the Mambili.

Publications of the Congo Museum.—After the Antwerp exhibition of 1894, it was resolved that the collections from the Congo there exhibited should form the nucleus of a museum, devoted to a furtherance of the scientific knowledge of the region in all its branches. Considerable materials have already been collected, while more are likely to be added as the result of various scientific expeditions recently sent out to the territories of the state. It has therefore been resolved to add to the general utility of the work by the issue of a series of publications, bearing the title *Annales du Musée du Congo*, which may in time form a "natural, physical, and ethnographical history of the basin of the Congo." The publications will be issued in three continuous series, dealing respectively with the botany, zoology, and anthropology of the Congo, and there will be also a special series of monographs on particular subjects, such as the results of scientific expeditions, descriptions of separate regions within the Congo basin, and the like. We have already received the opening number of the three regular series, the first under the title, 'Illustrations of the Flora of the Congo,' giving plates and descriptions of plants new to science brought to light by recent investigations; while the second ('Materials for the fauna of the Congo') does the same for zoology, the first numbers being devoted to the fishes of the Congo. The first number of the anthropological series is a review, by Dr. Stainier, of the Stone age in the Congo, as elucidated by the many discoveries of stone implements which have been made within recent years, principally on the lower Congo. The publications promise to be of much interest and value, and, if continued in the style in which they have been begun, should in course of time constitute a mine of information on scientific matters connected with the Congo region. From a geographical point of view, the special series of memoirs is likely to prove of most value, for by dealing with separate regions in turn, they may in time present a complete description of the whole country. A large number of scientists have already promised their co-operation.

German Steamer for Lake Tanganyika.—News has been received in Berlin from Lieut. Schloifer, leader of the expedition entrusted with the task of placing a steamer on Lake Tanganyika, announcing the arrival of his caravan at the south end of the lake in January last. In February he proceeded to Kosanga bay, north of the Anglo-German boundary, and decided to establish there his station for the

launching of the steamer. Lieut. Schloifer reached Tanganyika by Lake Nyasa and the Stephenson road.

New Railway for Angola.—It is announced in the *Mouvement Géographique* that, by a vote of the Portuguese Cortes, the Government has been authorized to construct and work a narrow-gauge railway from Benguela to the eastern frontier of Angola. Colonization will be encouraged along the line, and ports will be constructed at Benguela and Losito bay. The necessary funds are to be provided by taxes on the export of rubber and various industries, and by the sale of lands along the railway.

AMERICA.

The Volcanoes of the Aleutian Islands.—In a recent number of the *National Geographic Magazine* (No. 8, 1899), Mr. J. Stanley-Brown points out the interest of the field for exploration which exists, on a minor scale, in the volcanoes of the Eastern Aleutian isles, especially in Mount Shishaldin (Umniak island), whose summit has never yet been reached, Prof. Pinart's claim to have ascended the mountain being based, Mr. Stanley-Brown says, on a misunderstanding of the name of the particular peak climbed. Shishaldin is a splendid snow-clad peak nearly 9000 feet high, probably one of the most gigantic cinder cones in the world. It seems to be at present in a state of gentle eruption, lava streams, columns of smoke, etc., having been reported as observed during the last year or two. On the same island is another summit, which presents the appearance of a well-formed crater, and is probably the original volcano. It apparently equals Shishaldin in magnitude. There is likewise an active volcano on Akutan, the next island to the west, rings of smoke having, in 1892, been observed by Mr. Stanley-Brown to issue from the crater. Other partially active volcanoes occur within a radius of 100 miles, and their systematic study could be accomplished in a short field season. A mail-boat now runs once a month from Sitka to Unalaska under the control of the Pacific Steam Whaling Company.

An American War-ship on the Amazon.—The United States war-ship *Wilmington* has lately made its way up the Amazon as far as Iquitos, in Peru. The *Wilmington* is a cruiser of about 1300 tons displacement, and is said to be the first war-vessel of its size which has navigated the waters of the Solimoens or upper Amazon above the mouth of the Rio Negro. Navigation here was attended with some danger owing to quantities of driftwood brought down by the rapid current, and the absence of charts showing the nature of the channel. It is proposed, after replenishing the coal-supply at Manaos, to continue the examination of the Amazon system by an ascent of the Madeira to the falls.

Journey across the Gran Chaco.—It is stated in the *Comptes Rendus* of the Paris Geographical Society (1899, p. 285), that a boat journey has lately been made by a party of Argentine settlers from the province of Jujuy to the Parana by the Bermejo and its upper branches. The start was made from Esperanza on the Sora, a left-bank tributary of the Rio Grande de Jujuy. The navigation of these streams was extremely difficult, as they were at the time in flood, and very rapid. The scenery is picturesque on the upper Bermejo, but changes abruptly as the region of the Chaco is reached. The expedition, which was due to the initiative of the brothers Leach, is said to have proved that the rivers can be made navigable for large boats.

The Guayakis of Paraguay.—Some interesting details respecting the Guayakis, a little-known and exceedingly primitive tribe which inhabits the dense forests of Eastern Paraguay, are contributed to *Globus* (vol. 76, No. 5), by Dr. R. Lehmann Nitche. The little knowledge yet possessed respecting this tribe is

derived chiefly from the observations of Count Charles de la Hitte and Dr. Ten Kate, published in the *Anales del Museo de da Plata* for 1897, but before this date some information had been supplied by Herr Schutz in an article in the *Paraguay-Rundschau* (1894). The Guayakis are extremely shy, always taking to flight on being seen, while the thickness of the forests in which they dwell, and their extraordinary physical activity, effectually prevent their being followed. Herr Schutz was only once fortunate enough to obtain sight of an individual of the tribe—dark in colour and completely naked—who glided down from a tree and vanished in the depths of the forest in an instant. He learnt, however, from an old inhabitant of Carayao, that a Guayaki man was once captured by means of the boleadoras and brought to Asuncion, but of his subsequent fate no information could be obtained. The tribe is greatly hated by the settlers on account of the depredations committed by it on the young cattle and horses, and for this reason a merciless war is waged upon them whenever possible. In 1898 a settler came upon a Guayaki woman and two children in the forest, and captured one of the latter after wounding the mother. Photographs of the child were obtained by Dr. Endlich, of Leipzig, one of which is reproduced in *Globus*. The body is well nourished and in good proportion, the head large, and the forehead well developed. A few Guayaki words were noted by Dr. Endlich, but, while confirming to some extent previous information on the subject, are not sufficient to allow definite conclusions to be based upon them. The Guayakis are of special interest as living representatives of the Stone age, making use of a stone axe for obtaining honey from trees. They live solely on this and the produce of the chase.

Further Chilean Explorations in Patagonia.—Further news regarding last season's explorations of the Patagonian Andes from the Chilean side appears in the eighth number of *Petermanns Mitteilungen* for the present year. An expedition sent by the Chilean Government to open up a road from the valley of the Cochamo by the upper course of the Manso to the Valle Nuevo returned to Puerto Montt early in May. Its leaders were Herr Oskar von Fischer, a former Danish naval officer, and a German engineer, Franz Steeger. The road had been pushed forward about 15 miles, when torrents of rain put a stop to the work. Herr von Fischer had, however, explored three passes in the direction of the Rio Manso, that most suitable for a road leading south-east from the headwaters of the Cochamo * to the middle course of the Manso. It is some hundred metres above sea-level, and has, therefore, a covering of snow in winter, but other passes lie within the region of perpetual snow. Between Lake Nahuel Huapi and the Rio Puelo two chains run north and south, both starting from the Tronador. The higher bends eastward before turning south, and is characterized by bareness and rounded forms; it forms the continental water-parting. The other runs due south, and is steeper, though lower and thickly wooded on its western edge. It divides the Cochamo and other small streams flowing west from the valley of the Manso. The Valle Nuevo, which contains the upper courses of both the Manso and the Puelo, divided only by a slight swelling of the ground, is a warm and fertile valley, much drier than the rainy regions of Llanquihue and Chilce. Indians were found in the Manso valley, having made their way thither from Nahuel Huapi across the main water-parting. Information is also given respecting the latter part of Dr. Steffen's expedition (*ante*, pp. 96, 219). From the lake named by him Lake Cochrane (Pueyrredon of Dr. Moreno), Dr. Steffen proceeded south across the basaltic region of Southern Patagonia, a circuitous route being necessary on account of the stony

* The Cochamo is a small river running from the north-east into the head of the Boca de Reloncavi, in 41° 30′ S.

and waterless tablelands, which are almost impassable for pack-animals. As far as the Santa Cruz no settlers were seen. Crossing that river below its outflow from the Lago Argentino, Dr. Steffen passed round the Sierra Baguales—then impassable on account of snow—and reached Punta Arenas by way of Puerto Consuelo on Last Hope inlet, where are thriving sheep farms in the hands of German, Scottish, Portuguese, and other settlers. Dr. Steffen was much impressed by the rapid growth of Punta Arenas.

The American Inter-Oceanic Canal.—Two entirely opposite views respecting the commercial and strategic aspects of the proposed inter-oceanic canal are taken in articles which appear in the *National Geographic Magazine* for August last. In the first, Dr. J. Nimmo, while protesting against the almost exclusive attention hitherto directed to the engineering side of the question, examines the statements generally made as to the commercial prospects of the undertaking, which he declares to be entirely without foundation. Taking Manila as typical of the ports of Eastern Asia and Australia to which vessels would sail by the proposed canal from the Atlantic states of the Union, he shows that the Suez canal route has the advantage even in point of length of voyage, and that the advantage is even greater when the differing character of the two canals is considered. As a means of communication between the Atlantic and Pacific seaboards, or between the latter and the region between the Rocky mountains and Alleghanies, he holds that the canal route—not available for sailing ships, which form one-half of the American merchant marine—will have no chance of competing with the direct railway routes, on which freights are now reduced to a minimum. The diversion of trade to rival commercial centres which would necessarily result, even were the canal a success, is not, he says, calculated to recommend the project either to the centres of commerce east of the Missouri, which would lose the direct transcontinental trade, or to the Pacific ports, which would lose that to Asia and Australia. Contrasting the American schemes with that of Suez, Dr. Nimmo maintains that, while the Suez canal connects great commercial and industrial nations, and has no competing railway, any American isthmian canal would connect two vast unproductive oceans. The more orthodox view is upheld by Prof. E. R. Johnson, in an article originally written for the *New York Independent*. This writer regards it as almost self-evident that distances will be shortened * and expenses lessened by the new route, and devotes the greater part of his article to an examination of the effects which such modifications will have on American naval power, industries, and commerce. The construction of the canal will, he holds, by adding to the effectiveness of existing ships, effect an immense saving in the naval outlay of the country, and will be of equal importance as regards its industrial development, especially by supplying a much-needed outlet to the manufactures and products of the eastern states. The two writers draw entirely opposite conclusions from the same facts. Thus, Prof. Johnson regards traffic by land handicapped by the costs of railway carriage, while he considers that the central west has benefited greatly by the water route *viâ* the great lakes and Erie canal; Dr. Nimmo, on the other hand, laying stress on the recent enormous falling off of the tonnage by the latter. Prof. Johnson allows that a new trade will have to be created to make the canal a success, but has no doubt as to the result, holding that the industrial and

* Whereas Dr. Nimmo based his argument, with regard to Asia and Australia, on the distances to Manila only, Prof. Johnson shows that as regards Australia, Japan, and China north of Shanghai, the proposed canal would be of decided advantage to the Eastern United States.

commercial development produced by the canal will more than make good any loss temporarily experienced by the railways.

AUSTRALASIA AND OCEANIC ISLANDS.

The Germans in the New Britain Group.—The *Deutsches Kolonialblatt* for July 1 contains the account of a visit of inspection made early in the present year by the acting governor, Herr Schnee, to the various trading stations in New Hannover, New Ireland, and adjoining islands. The natives were found in most cases well disposed to Europeans, but at constant feud among themselves, the Government being not yet in a position to put a stop to this state of things. The principal stations are on the small island of Nusa, off the north-western extremity of New Ireland, and at other points on the Nusa channel, as well as on the neighbouring coasts of New Hannover and New Ireland. Some of these, established by the New Guinea Company, are in the charge of Chinese or Malays. Cannibalism is still openly practised in these districts, and can only be checked when the authorities obtain a firmer control over the natives. A visit was paid to the Gardner islands, north of New Ireland, and here the discovery was made that both of the large islands shown on the maps are in reality cut through by narrow channels. Herr Schnee passed through such a channel, bordered with mangroves, from side to side of the northern island. During a short excursion into the interior, partly by the bed of a mountain stream, Herr Schnee was struck by resemblance to Amboina in respect of the soil and vegetation. The former was rich loam, and the growth of plants luxuriant. The tribal chiefs seem here to exercise a much greater influence than on New Britain and the parts of New Ireland that were visited. After beating about for ten days between the Gardner islands and New Ireland, unable to make any progress on account of the strong current, Herr Schnee returned by Nusa to Herbertshöhe, the seat of government on the Gazelle peninsula. He had, shortly before this voyage, undertaken a successful expedition against the Anaparpar people in the interior of the peninsula, who had lately given trouble on the coast of Weber Hafen, where, after a temporary abandonment, Europeans have again begun to form settlements.

POLAR REGIONS.

The Arctic Expeditions.—Further details respecting Peary's experiences and work during the past year are published in the St. John's *Evening Herald* of September 11 and the Brooklyn *Standard Union* of September 14. A map* is also sent us by the Peary Arctic Club at Lieut. Peary's request, which shows the exploring work accomplished in 1898–99. After parting with the *Hope* at Etah on Foulke fiord (*ante*, p. 326), the *Windward* steamed north, but, the ice being soon found unfavourable for a far advance, was placed in winter quarters abreast of Cape D'Urville at the entrance to Allman bay, Grinnell Land. Here the ship was frozen in on August 18, the whole basin and channel having been blocked all the season with heavy ice. After successful hunting operations during the autumn, Peary set out northwards along the eastern edge of the land, making caches of provisions *en route*, and by the middle of December made his way to Fort Conger, Greely's old winter quarters on Lady Franklin bay. The house was found quite undisturbed, no traveller having passed that way during the fifteen years which had elapsed since the former explorers had left it. It was during the last march that the misadventure occurred which obliged Peary and his party to spend the night in the cavity of an iceberg, and necessitated his return to the *Windward* and the amputation of seven toes. When recovered, he set

* See map, p. 592.

himself to explore Grinnell Land, which he crossed to its west coast. Good work was done in the neighbourhood of Buchanan strait and Princess Marie bay, both of which were surveyed and charted, while the supposed Hayes sound was found to have no existence. Much was accomplished in preparation for a northward advance next year, the track between Cape Sabine and Fort Conger having been so well trodden that it is likened by Peary to a post-road. In some respects the explorer has modified his plans for the future, as he intends to winter at Etah, whither he proceeded in August as soon as the *Windward* got clear of the ice. He will again take the field with the first light of the new year, whilst the *Windward*, which will be refitted and re-engined during the winter, will return north equipped for three years' further service, and will serve as a *depôt* ship at the furthest point north attainable. Captain Sverdrup's expedition in the *Fram* wintered about 50 miles south of the *Windward*, at Cocked Hat island, just within Cape Sabine, the death of the surgeon, Svensen, being the only misfortune which befell the party. Some exploration was accomplished in Ellesmere Land. On August 18 the *Fram* was off Littleton island, and the chances of reaching an advanced point on the north coast of Greenland this season seemed to be slight. The *Standard Union* contains a full account of the Peary auxiliary expedition of 1899 in the *Diana*, which made an unusually rapid passage across Melville bay owing to absence of ice. At Saunders island a note from Peary was delivered by the Eskimo, and at Foulke fiord, Henson, Peary's coloured companion, was found with a letter from Captain Bartlett of the *Windward*. Finally, after cruising north of Smith sound and reaching 79° 10′ N., the *Windward* was found anchored off Etah on August 12, and Peary encamped close by. The *Diana* arrived at Sidney, C.B., on September 12, little more than a day after the *Windward*. When still 2000 miles from home, the stock of coal had given out; but a supply was fortunately obtained from Disco island (where Sir Allen Young had coaled the *Pandora* in 1875–76), the whole crew turning to dig, aided by a party of Eskimo.

Dr. Robert Stein's Arctic Expedition.—We have already mentioned (*ante*, p. 326) that a party, headed by Dr. Robert Stein, of Washington, was taken out to Ellesmere Land in the *Diana* by the Peary Auxiliary Expedition of the past summer. Since the return of the *Diana*, Mr. Bridgman has communicated to the *Standard Union* some account of the plans and prospects of the party, which, in conformity with previous arrangements, was landed early in August at Cape Sabine, with the object of exploring Ellesmere Land. Dr. Stein, who is accompanied by Leopold Kann and Samuel Warmbath, purposed to winter in that neighbourhood, hoping to have an opportunity of returning by one of Peary's steamers next year. According to present arrangements, however, the *Windward* will proceed north next summer, and not return till Peary's work is finished; so that, as Mr. Bridgman remarks, it will be incumbent on Dr. Stein's friends to make some arrangements, either to bring him home or possibly to send by the *Windward* stores to enable him to spend another winter in the arctic. The fact that the *Fram* wintered last year in the neighbourhood of Ellesmere Land makes it doubtful whether much new work will be left for Dr. Stein and his companions to accomplish, and they seem, besides, to be badly equipped for journeys of any extent.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Tidal Observations round the Coast of England and Wales.—In 1896 the Ordnance Survey conducted a series of tidal observations round the coast of England and Wales for the purposes of the survey itself, and with a view to ascertain whether the observations undertaken in 1859 still remained approximately correct. A circular on the subject by Colonel Sir J. Farquharson, the late Director-

General of the Ordnance Survey, has recently appeared as an Addendum to the 'Abstract of the Ordnance Survey Spirit Levelling of England and Wales,' issued in 1861. Taking the result as a whole, there is only a difference of $1\frac{3}{8}$ inch between the results of 1859 and 1896, which indicates that there has been practically no change in the mean level of the sea round England and Wales during the last forty years. The following tables give the results of observations taken in 1859 and 1896.

LEVELS OF THE SEA ABOVE THE ORDNANCE DATUM.

1859.	
Appledore	+0·690
*Battersea	+2·500
Berwick-on-Tweed	+0·389
Birkenhead	+1·113
Cardigan	+0·779
*Deptford	+2·020
Dover	+0·417
Falmouth	−0·001
Fleetwood (mean)	+1·388
Great Grimsby	+1·814
Harwich	+1·883
Holyhead	+0·462
Hull	+0·688
Liverpool	−0·068
*London Bridge	+2·440
Lowestoft	+1·382
Lyme Cobb	+1·490
North Shields	+0·990
Pembroke	+0·554
Penzance	+0·004
Plymouth	−0·359
Portsmouth	+0·302
Ramsgate	+0·974
Scarborough	+0·334
Sheerness	+1·448
Shoreham	+0·189
Silloth	−0·633
Southampton	+0·791
Sunderland	+0·714
Torquay	+0·433
Western-super-Mare	+0·121
Weymouth	+0·561

Mean sea-level at twenty-nine stations above the ordnance datum at Liverpool, +0·650 foot.

* Omitted for calculating the mean.

1896.	
Berwick-on-Tweed	+0·457
Brighton	+0·711
Cardigan	+1·391
Cardiff	+0·994
Dover	+0·532
Falmouth	+0·017
Fleetwood	+0·738
Harwich	+1·657
Holyhead	−0·242
Hull	+1·044
Liverpool	−0·057
Lowestoft	+1·567
Milford	−0·653
New Brighton	−0·315
Penzance	+0·662
Portland	+0·213
*Rotherhithe	+2·167
Sheerness	+1·551
Silloth	+0·358
Tynemouth	−0·213
Torquay	+0·377
West Hartlepool	−0·020
Weston-super-Mare	+0·611

Mean sea-level at twenty-two stations above the ordnance datum at Liverpool, +0·517 foot.

* Omitted for calculating the mean.

OBITUARY.

Chief Justice Charles P. Daly, LL.D.

OUR honorary corresponding member, Judge Daly, died at his country seat, near Sag Harbour, New York, on September 19, at the age of eighty-four years. His strength had perceptibly failed since his return from Europe in 1895, but his mind retained its serenity and vigour to the end.

He was born October 31, 1815, in the city of New York. His father, a master carpenter, died while the boy was still at school, and thus thrown upon his own resources, Charles obtained employment as a merchant's clerk at Savannah, Georgia, and not long after shipped as a sailor. After three years at sea he settled

in New York, learned a trade, and spent his evenings in study. At the close of his apprenticeship, he entered the law office of Mr. William Soule, where in less than four years he acquired such proficiency that Chief Justice Nelson, in 1839, relaxed in his favour the rule requiring seven years' study, and admitted him to practice.

In 1843 he was elected to the Legislature, and in the following year was appointed, on the recommendation of ex-Governor Marcy, Judge of the Court of Common Pleas. He took his seat May 4, 1844, and served continuously for nearly forty-two years, being retired December 31, 1885, by the limitation of age. He became Chief Justice in 1871. His judicial integrity and ability made an abiding impression upon the community, and his seat was never imperilled at any election, while in one particularly bitter contest he was the candidate of both parties and received every vote cast.

The degree of LL.D. was conferred upon Judge Daly in 1860 by Columbia College, in recognition of his eminence as a jurist and his wide and varied literary culture. His studies in history had stimulated his early interest in geography, and he became a Fellow of the American Geographical Society not long after its foundation. He was elected President in 1864, and re-elected every year for thirty-five years. His annual addresses often dealt with particular subjects, mostly with a bearing on the historical side of geography. Thus in 1879 he gave a useful sketch of the early history of cartography, while in 1893 he discussed the subject of the genuineness of the portrait of Columbus which has come down to us. His devotion to the aims of the Society was unwearied, and he was foremost in every effort to promote the study of geography in America. He gave special attention to the growth and development of the Society's library, to which he contributed generously from his own collection.

Judge Daly had travelled extensively in Europe. He represented his Society at the Venice meeting of the International Geographical Congress in 1881, and again at the London meeting of 1895, being chosen on the latter occasion to reply on behalf of the foreign members to the addresses of welcome delivered at the opening meeting. He was an honorary member of the Geographical Societies of Berlin and St. Petersburg, as well as of our own.

A man of singularly sweet nature, dignified and modest, he possessed an irresistible charm of manner. His long married life, though unblessed by children, was a period of unbroken happiness. Mrs. Daly died in 1894.

William Simpson.

The veteran war artist of the *Illustrated London News*, Mr. William Simpson, who died in August last at his residence at Willesden, had been a Fellow of our Society since 1863. Mr. Simpson's professional employments had given him a wide acquaintance with foreign countries, and had taken him to some out-of-the-way places, so that his experiences were of the most varied character. More than twenty years ago he read a paper before our Society on the Modoc regions of California (printed in vol. xix. of the old series of *Proceedings*), and a few years later he gave the British Association the benefit of his experiences in Afghanistan, whither he had proceeded with the Peshawur Field force, under Sir Samuel Browne. During the stay of the troops at Jalalabad, he made interesting archæological explorations in the neighbourhood, which threw some light on the Buddhist period in that valley. Mr. Simpson was born at Glasgow in 1823, and educated at that city and at Perth. He had at first given his attention to architecture, but soon took up art as a profession. He went through the Crimean war, the Abyssinian

campaign, and the Franco-German war, as well as the Afghan war of 1878–79. During his first visit to India he spent some time in the investigation of Buddhist topes, while some years later he visited the Troad to illustrate the scene of Dr. Schliemann's explorations. Russia and China also fell within the scope of his extensive travels.

Dr. Oskar Baumann.

Dr. Oskar Baumann, one of the best known of the modern generation of African explorers, has lately died at Vienna at the early age of thirty-five years. Dr. Baumann's African work began when he was only twenty-one, his attention being first directed to the west coast, whither he accompanied Dr. Lenz on his Congo expedition of 1885. Dr. Baumann's survey of the lower and middle course of the river on this occasion supplied valuable additions to African cartography. In 1888 he turned his steps to German East Africa, with which the rest of his work as an explorer was concerned. After minor expeditions in Usambara and other regions near the coast, he set out in 1898 on the important journey to the Nile sources, which will be remembered as his principal achievement. The route was so planned as to traverse a large extent of new ground, and the additions to our knowledge, both of the region of steppes and inland drainage between the Kilimanjaro and the Victoria Nyanza, and of the south-western watershed of the Nile, were of much value. Dr. Baumann's work was marked by great thoroughness, and the work in which this journey was described still ranks as one of the best authorities on the geography and ethnology of East Africa. He afterwards did good work by executing a survey of Zanzibar island and its neighbours on the East African coast. He was for a time Austrian consul at Zanzibar, where he contracted the malady to which he has now succumbed.

CORRESPONDENCE.

"Was Australia Discovered in the Sixteenth Century?"

Haigh Hall, Wigan, October 10, 1899.

MAY I be allowed to point out an inaccuracy in the footnote on p. 421 to Mr. Edward Heawood's paper, "Was Australia discovered in the Sixteenth Century?" In referring to the early French maps, he states that "Three of these maps, now in the British Museum, were last year published in facsimile by the late Mr. C. H. Coote, with explanatory letterpress." This is a most misleading statement, and in the future may give rise to vain inquiries. The Harleian (circa 1536) map, and the Desceliers map, dated 1550, are in the British Museum; but the Desceliers map of 1546 is in the library of the Earl of Crawford at Haigh Hall. I may further add that the facsimiles were privately printed by the Earl of Crawford, and were not published by Mr. Coote, although he wrote an introduction which was issued at the same time. I cannot understand the suppression of Pierre Desceliers' name in Mr. Heawood's article. One would naturally conclude that all three maps are anonymous, whereas the second and third are signed and dated.

J. P. EDMOND.

[I much regret the inaccuracy to which Mr. Edmond calls attention, and can only plead in excuse that the note in question was added from memory when at a distance from all means of verification, in expectation of an opportunity—which did not occur—for further revision. The omission—entirely unintentional—of Desceliers' name arose probably in part from the wish to reduce to a minimum the

recapitulation of well-known facts, and in part because attention was directed rather to the unknown prototype on which all the maps, as regards this part of the world, appear to be based, than to the existing maps themselves. I find on referring to the rough copy of the article that the name originally appeared, but was eliminated through subsequent compression.*—E. HEAWOOD.]

Andrée's Route.

It cannot fail to be of interest, and it may be of use to those who contemplate a search expedition for Herr Andrée, to be in possession of the following record of winds in his neighbourhood for a few days after his ascent. I sent it to the *Times*, and it appeared in the issue of that paper of October 10.

"The discovery of a buoy, unquestionably belonging to Andrée's balloon, has again revived speculation as to the course followed by the Eagle after the ascent from Spitsbergen; and it has occurred to me that a few notes of the wind and weather experienced within about 300 miles of the balloon for certainly three days after it started should be of value in assisting opinion.

"Now, when Andrée started on July 11, 1897, the *Windward* (the ship purchased by Mr. Harmsworth for his expedition and afterwards given by him to Lieut. Peary for further arctic work) was about this distance from him, dodging about in the close-packed ice south of Franz Josef Land. When Andrée ascended the wind with him was S.S.W., driving him in a N.N.E. direction. At that moment a light south-east wind was still with the *Windward;* but on the following day, about twenty-four hours later, the south-west wind reached her. July 13 was ushered in with snow, and a heavy swell came up from the south-west, resulting from the wind which had blown from that direction the day before. On July 13 Andrée despatched the only message we have received from him, in which he said he was in 82° 2′ N. lat. and 15° 5′ E. long., and was going east 10° south; or, in other words, was being driven by a wind north of west. Almost exactly twenty-four hours later—as before—the wind reached the *Windward*, on July 14, and lasted for about twelve hours. The weather had varied from cloudy to clear, but this wind brought dense fog. On July 15, at 8 a.m., when Andrée might have been somewhere north-east of the *Windward*—perhaps not more than 200 miles distant—the wind again shifted, this time to the south, and from that quarter it blew with steadily increasing force throughout the day (with considerable rain), veering in the night to south-west.

"If I may offer an opinion, I would say that if the weather which his neighbour the *Windward* had be any criterion, the fresh and strong southerly breezes of July 15 would have carried Andrée far to the north."

It is open to us, from the foregoing facts, to believe that Herr Andrée turned north in his balloon, on July 15, when somewhere north-west of the north point of Nova Zembla—probably about 60° E. long. and 80° N. lat. The appearance of the buoy on the north coast of King Charles Land would not be inconsistent with this assumption.

ARTHUR MONTEFIORE BRICE.

1D, Hyde Park Mansions, W.

* A printer's error which occurs on p. 425 may be noted here. Since the type was first set up two of the letters of the word "Aljofar" (four lines from bottom) have become transposed.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. = Memoirs, Mémoires.
Met. = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Austria-Hungary. *Jahrb. Ungar. Karpathen-V.* **26** (1899): 56–90. **Loysch.**

Die Orometrie der Hohen Tátra. Von Edmund Loysch.

Austria—Meteorology. ——

Jahrbücher der k. k. Central-Anstalt für Meteorologie und Erdmagnetismus. Jahrgang 1895, 1896, und 1898. I. Theil. Wien, 1898–99. Size 12 × 9½, pp. (1895) xxiv. and 192; (1896) xxvi. and 148; (1898, I. Th.) 134, 38, and 16.

Austria—Moravia. *M.G. Ges. Wien* **42** (1899): 193–209. **Trampler.**

Das Holsteiner Thal; eine Karststudie aus Mähren. Von R. Trampler. *With Plans.*

Belgium. *Rev. Française* **24** (1899): 517–522. **Barré.**

La Belgique maritime. Par M. Paul Barré. *With Maps and Plan.*

On the seaports of Belgium, and the proposals for improving them.

Denmark—Bornholm. *Globus* **76** (1899): 85–91; 117–127. **Buschan.**

Bornholm. Von Dr. G. Buschan. *With Map and Illustrations.*

Denmark—Copenhagen. *B.S.G. Com. Bordeaux* **22** (1899): 339–367. **Ferrière.**

Le port franc de Copenhague. Par M. André Ferrière.

Europe—Anthropology. **Ripley.**

A Selected Bibliography of the Anthropology and Ethnology of Europe. By William Z. Ripley, PH.D., Boston. Published by the Trustees of the Public Library, 1899. Size 9 × 6, pp. x. and 160. *Presented by the Compiler.*

This list contains nearly two thousand titles of works referred to by Prof. Ripley in compiling his "Races of Europe." They are arranged alphabetically under authors' names, with an index arranged alphabetically under subjects, the subjects including countries and provinces.

Europe—Fauna. **Scharff.**

The History of the European Fauna. By R. F. Scharff, B.SC. London: W. Scott, Limited, 1899. Size 7½ × 5, pp. viii. and 364. *Maps and Illustrations. Price* 6*s. Presented by the Publishers.*

A special note on this important book will be given in the *Journal*.

France. *B.S.G. Rochefort* **20** (1898): 3, 81, 161, 225; **21** (1899): 3. **Vincent.**

Une paroisse, autrefois, en Angoumois (Marillac-le-Franc). Par Ernest Vincent.

France—Chamonix. **Whymper.**

Chamonix and the range of Mont Blanc. A Guide by Edward Whymper. Fourth edition. London: John Murray, 1899. Size 7½ × 5, pp. xiv. and 206. *Maps and Illustrations. Price* 3*s. Presented by the Author.*

France—Corsica. *Globus* **76** (1899): 1–3; 27–31. **Ratzel.**

Korsische Städte. Von Friedrich Ratzel.

Germany—Halle. *M.V. Erdk. Halle* (1899): 108–110. **Lorenz.**

Beschreibung der Stadt Halle im 16 Jahrhundert. Aus einer Handschrift G. v. Alvensleben's mitgeteilt von G. Lorenz.

Germany—Prussia. *M.V. Erdk. Halle* (1899): 59–64. **Halbfass.**

Der Arendsee in der Altmark (Nachträge). Von Dr. W. Halbfass.

Germany—Prussia. *M.V. Erdk. Halle* (1899): 1–55. **Mertens.**

Der Hopfenbau in der Altmark. Von Dr. A. Mertens. *With Map.*

On the distribution of hop-growing in the Altmark.

Germany—Prussia. *Globus* **76** (1899): 181–192. **Tetzner.**

Die Philipponen in Ostpreussen. Von Dr. F. Tetzner. *With Map and Illustrations.*

The Philipponen were a Russian sect who emigrated to East Prussia in 1700.

Germany—Prussia. *M.V. Erdk. Halle* (1899): 89–96. **Weyhe.**

Wüstungen im und am Kliekener Luch. Von Prof. E. Weyhe. *With Map.*

Russia—Odessa. **Mackie.**

Trade of Odessa for the year 1898. Foreign Office, Annual No. 2255, 1899. Size 10 × 6½, pp. 38. *Price* 2½*d.*

Russia—Poland. **Murray.**

Trade and Agriculture of Poland and Lithuania for the year 1898. Foreign Office, Annual No. 2226, 1899. Size 9½ × 6½, pp. 54. *Map. Price* 4½*d.*

Russia—Taganrog. **Hunt.**

Trade of Taganrog and District for the year 1898. Foreign Office, Annual No. 2265, 1899. Size 9½ × 6, pp. 34. *Price* 2½.

Russia—Urals. **Högbom.**

Om de vid syenitbergarter bundna jernmalmerna i östra Ural. Af A. G. Högbom. —Meddelanden från Upsala Universitets Mineralogisk-Geologiska Institution. 23. Stockholm, 1898. Size 8½ × 5½, pp. 115–134. *Illustrations.*

Scandinavia. *G. Tidskrift* **15** (1899): 40–52. **Geer.**

Gerard de Geer: Om Skandinaviens geografiska utveckling efter istiden. Referat af cand. mag. N. Hartz.

A summary of Prof. Gerard de Geer's work on the geographical evolution of Scandinavia since the glacial period, published in Stockholm in 1896.

Spain. **Harrison.**

Trade of Spain for the year 1898. Foreign Office, Annual No. 2245, 1899. Size 10 × 6½, pp. 54. *Price* 3*d.*

Spain—Bilbao. **Smith.**

Trade of Bilbao and District for the Year 1898. Foreign Office, Annual No. 2240, 1899. Size 10 × 6, pp. 40. *Price* 2½*d.*

Spain—Cadiz. **Vecqueray.**

Trade of Consular District of Cadiz for the year 1898. Foreign Office, Annual No. 2223, 1899. Size 9½ × 6, pp. 30. *Price* 2*d.*

This report describes the progressive decline of the port of Cadiz, and refers to the efforts being made to restore prosperity by running the "Sud express," which now stops at Madrid on to Cadiz, and so making it a port for passengers joining the Mediterranean steamers.

Sweden—Geology. **Högbom.**

Om urkalkstenarnas topografi och den glaciala erosionen. Af A. G. Högbom.—Meddelanden från Upsala Universitets Mineralogisk-Geologiska Institution. 24. Stockholm, 1899. Size 8½ × 5½, pp. 189–206.

Sweden—Gravity. *Bihang K. Svensk. Vet.-A. Handlingar* **24** (1899): 1–36. **Rosén.**

Bestimmung der Intensität der Schwerkraft auf den Stationen Haparanda, Hernösand, Upsala, Stockholm und Lund. Von P. G. Rosén.

Sweden—Meteorology.

Observations Météorologiques Suédoises publiées par l'Académie Royale des Sciences de Suède, exécutées et rédigées sous la direction de l'Institut Central de Météorologie, vol. 35, 2-ième série; vol. 21. 1893. Stockholm, 1898. Size 12½ × 10, pp. viii. and 156.

Switzerland. *Geolog. Mag.* **6** (1899): 259–270. **Jennings.**

On the Courses of the Landwasser and the Landquart. By A. Vaughan Jennings. *With Maps.*

Discusses Prof. Heim's theory as to the changes which have taken place in the mountain streams of Graubunden, in which he sees evidence of river-capture. Mr. Jennings, after studying the locality, brings forward another theory to account for the present condition of the Davos valley.

Switzerland—Folklore. **Zahler.**

Die Krankheit im Volksglauben des Simmenthals. Ein Beitrag zur Ethnographie des Berner Oberlandes. Von Dr. Hans Zahler.—Arbeiten aus dem Geographischen Institut der Universität Bern. Heft iv. (Separat-Abdruck aus dem XVI. Jahresbericht der Geographischen Gesellschaft von Bern.) Bern, 1898. Size 9 × 6½, pp. 140. *Presented by the Author.*

On the popular superstitious beliefs as to illness in the Simmenthal.

Switzerland—Geology. **Früh.**

Vierteljahrsb. Naturforsch. Ges. Zürich **44** (1899): 157–191.

Der postglaciale Löss im St. Galler Rheinthal mit Berücksichtigung der Lössfrage im allgemeinen. Von J. Früh.

A contribution to the study of the origin of loess.

Turkey—Albania. *Scottish G. Mag.* **15** (1899): 337–350. **Callan.**

Albania and the Albanians in 1898. By the Rev. Hugh Callan, M.A. *With Illustrations.*

United Kingdom. *Yorkshire Ramblers' Club J.* **1** (1899): 54–64. **Cuttriss.**

The Caves and Pot-Holes of Yorkshire. By S. W. Cuttriss.

United Kingdom. *Yorkshire Ramblers' Club J.* **1** (1899): 49–53. **Robinson.**

The West Wall of Deep Ghyll. By J. W. Robinson.

United Kingdom—England.

Tidal Observations and Ordnance Survey Levelling. Addendum to the "Abstract of the Ordnance Survey Spirit Levelling of England and Wales." Issued in 1861. Size 12½ × 10, pp. 4.

Results of redetermining mean sea-level at a number of stations on the coast of England and Wales, in order to place on record the difference between assumed mean tide-level at Liverpool—the datum for all the Ordnance Survey levelling—and the actual mean sea-level at different points, see *Journal*, p. 572.

United Kingdom—England. **Baxendell.**

Borough of Southport. Meteorological Department. The Fernley Observatory, Southport. Report and Results of Observations for the year 1898. By Joseph Baxendell. Southport, 1899. Size 10 × 7½, pp. 28. *Diagram.*

United Kingdom—England. **Cornish.**

On the Grading of the Chesil Beach Shingle. By Vaughan Cornish, M.Sc., etc. [From *Proceedings* Dorset Natural History and Antiquarian Field Club, vol. xix., 1898, pp. 113–121.] Dorchester, 1898. Size 8½ × 6. *Illustrations. Presented by the Author.*

United Kingdom—England. *T. Edinburgh Geolog. S.* **7** (1899): 469–476. **Greenly.**

The Hereford Earthquake of December 17, 1896, considered in relation to Geological Structure in the Bangor-Anglesey Region. By Edward Greenly. *With Map.*

United Kingdom—England. **Nares.**

Report on the Present State of the Navigation of the River Mersey (1898), to the Right Honourable the Commissioners for the Conservancy of the River Mersey. By Vice-Admiral Sir G. S. Nares, K.C.B., F.R.S. London: Printed by Phipps & Connor, 1899. Size 10 × 6½, pp. 20. *Presented by the Mersey Conservancy.*

United Kingdom—Meteorology. *J. School G.* **3** (1899): 223–227. **Herbertson.**
Pressure, Winds, and Rainfall over the British Islands. By A. J. Herbertson.

United Kingdom—Scotland. *T. Edinburgh Geolog. S.* **7** (1899): 416–419. **Wallace.**
Geological Notes on Strathdearn and the Aviemore Railway. By Thomas D. Wallace.

Observations on the new line which cuts off a wide curve on the Highland railway between Aviemore and Inverness.

ASIA.

Asia Minor. *B.S.R. Belge G.* **23** (1899): 205–231. **Oehlmann.**
L'Asie Mineure au point de vue de l'emigration allemande. Par le Dr. E. Oehlmann.

China. *C. Rd. S.G. Paris* (1899): 271–281. **Fauvel.**
Les diamants Chinois. Par M. A. A. Fauvel.

China. *M.G. Ges. Wien* **42** (1899): 210–234. **Fischer.**
Meine Erlebnisse an der Ostküste Chinas. Von E. S. Fischer.

China. *J. Manchester G.S.* **14** (1898): 361–364. **Little.**
China. By Mrs. A. Little.

China—Che-Kiang. **Carli.**
Il Ce-Kiang, studio geografico-economico del Dott. Mario Carli. Roma, 1899. Size 9½ × 6½, pp. xx. and 278. *Map. Presented by the Author.*

China—Historical. *B.S.G. Lisboa* **16** (1897): 649–661. **Montalto de Jesus.**
Centenary of India. Early Portuguese intercourse with China. By C. A. Montalto de Jesus.

China—Tientsin. *B.S.R. Belge G.* **23** (1899): 232–268. **Bure.**
Tientsin. Par Pierre Bure.

India. *Contemporary Rev.* **76** (1899): 153–173. **Fairbairn.**
Race and Religion in India. By A. M. Fairbairn, D.D.

India—Darjiling. *Globus* **76** (1899): 192–195. ———
Ein Besuch in Dardschiling. *With Illustrations.*

India—Historical. **Foster.**
The Embassy of Sir Thomas Roe to the Court of the Great Mogul, 1615–1619, as narrated in his Journal and Correspondence. Edited from Contemporary Records by William Foster, B.A. 2 vols. London: Printed for the Hakluyt Society, 1899. Size 9 × 6, pp. xii., lxviii., and 586. *Portrait, Maps, and Illustrations. Presented by the Hakluyt Society.*

This edition of Sir Thomas Roe's embassy is largely printed for the first time from Roe's original manuscript, supplemented, where it is incomplete, from Purchas, and accompanied by numerous letters and notes throwing light from contemporary sources on some of the references.

India—Karakoram Mountains. *Scottish G. Mag.* **15** (1899): 523–526. **Workman.**
Ascent of the Biafo Glacier and Hispar Pass: Two Pioneer Ascents in the Karakoram. By Fanny Bullock Workman.

India—Kashmir. *Mem. Geolog. Surv. India* **28** (1898): 1–27. **Diener.**
Notes on the Geological Structure of the Chitichun Region. By Dr. Carl Diener.

India—Madras—Anthropology. **Thurston.**
Madras Government Museum. Bulletin, vol. ii. No. 3. Anthropology. Kādirs of the Anaimalais; Malaiālis of the Shevaroys; Syllabus of Demonstrations on Anthropology; The Dravidian Head; The Dravidian Problem. By Edgar Thurston. Madras, 1899. Size 8½ × 5½, pp. 131–197. *Illustrations.*

India—North-West Frontier. *Mem. Geolog. Surv. India* **28** (1898): 96–117. **Hayden.**
On the Geology of Tirah and the Bazar Valley. By H. H. Hayden, B.A., B.E. *With Plate and Sections.*

India—Vizagapatam. ———
Report of the Condition and Progress of the G. V. Juggarow Observatory, Vizagapatam. Including the Results of Observations for the year 1897. Calcutta, 1899. Size 9 × 6½, pp. 60. *Plate and Diagram.*

Indo-China—Laos. *B.S.G. Com. Paris* **20** (1898): 609–625. **Lefèvre.**
Le Haut Laos, sa situation économique. Par M. le Dr. Lefèvre. *With Map.*

Japan. *National G. Mag.* **10** (1899): 329–337. **Austin.**
The Commercial Development of Japan. By O. P. Austin.

Japan. *J.G. Tokyo G.S.* **11** (1899): 413–422, 475–504. **Ogawa.**
Geologic Structure of the Japanese Islands. By Takudzi Ogawa. [In Japanese.]

Japan. *J.G. Tokyo G.S.* **11** (1899): 194–203. **Suzuki.**
The Otsuji Coal-fields in Onga, Chikuzen. By Toshi Suzuki. [In Japanese.]

Japan. **Gowland.**
The Dolmens of Japan and their Builders. By W. Gowland. Reprinted from the *Transactions and Proceedings of the Japan Society*, vol. iv. part iii. London: Printed by W. Clowes & Sons, 1899. Size 11 × 8, pp. 56. *Illustrations. Presented by the Author.*

The author has studied 406 dolmens or ancient stone-built sepulchral chambers in Japan, and made drawings or measurements of 140. On these the present paper is founded.

Japan. **Lay.**
Foreign Trade of Japan for the year 1898. Foreign Office, Annual No. 2277, 1899. Size 9½ × 6, pp. 32. *Price* 2*d.*

Japan—Coal. *J.G., Tokyo G.S.* **11** (1899): 114–125. **Suzuki.**
The Otsuji Coal-fields in Onga, Chikuzen. By Toshi Suzuki. [In Japanese.]

Japan—Formosa. *J.G., Tokyo G.S.* **11** (1899): 33–44. **Inouye.**
Present and Future of the Industries of Formosa. By Jintarō Inouye. [In Japanese.]

Japan—Formosa. *J.G., Tokyo G.S.* **11** (1899): 126–136. **Ishii.**
A Geological Exploration of Formosa. By Yamajiro Ishii. [In Japanese.]

Japan—Formosa. *J.G., Tokyo G.S.* **11** (1899): 16–32. **Ishii.**
A Geological Exploration of Formosa. By Yamajiro Ishii. [In Japanese.]

Japan—Yokohama. **Forster.**
Trade of Yokohama and District for the year 1898. Foreign Office, Annual No. 2290, 1899. Size 10 × 6½, pp. 24. *Price* 1½*d.*

Korea. **Jordan.**
Trade of Corea for the year 1898. Foreign Office, Annual No. 2304, 1899. Size 9½ × 6, pp. 24. *Price* 1½*d.*

Malay Archipelago. *J. College Sci. Imp. University Tokyo* **11** (1899): 83–120. **Kotô.**
On the Geologic Structure of the Malayan Archipelago. By B. Kotô, PH.D. *With Map.*

Malay Archipelago—Celebes. **Kruijt.**
Tijds. Indische Taal-, Land- en Volkenk. **41** (1899): 80–92.
De adoptie in verband met het matriarchaat bij de Toradja's van Midden-Celebes. Door Alb. C. Kruijt.

On the customs of the people of Central Celebes.

Malay Archipelago—Java. **Chapelle.**
Tijds. Indische Taal-, Land- en Volkenk. **41** (1899): 32–54.
Nota betreffende het Jengger-gebied. Door H. M. la Chapelle.

Malay Archipelago—Java. **Kohlbrugge.**
Tijds. Indische Taal-, Land- en Volkenk. **41** (1899): 70–79.
De Linggatempel en andere oudheden op het Yanggebergte. Door Dr. J. H. F. Kohlbrugge. *With Plan and Plates.*

Malay Archipelago—Java. **McLachlan.**
Trade of Java for the year 1898. Foreign Office, Annual No. 2253, 1899. Size 9½ × 6½, pp. 22. *Price* 1½*d.*

Malay Peninsula. *J.R. Colonial I.* **30** (1899): 549–581. **Clifford.**
Life in the Malay Peninsula; 'As it was and is.' By Hugh Clifford.

Malay States. **Swettenham.**

Report by the Resident-General of the Federated Malay States to His Honour the Acting High Commissioner (Sir Alexander Swettenham, K.C.M.G.). Kuala Lumpur, 1899. Size 13½ × 8½, pp. 8.

Persia. *J.R. United Service I.* **43** (1899): 737–751. **Temple.**

The Strategic Relation of Persia to British Interests. Lecture by the Rt. Hon. Sir Richard Temple, Bart., G.C.S.I., etc.

Discusses the relations of Persia to Russia and the United Kingdom.

Persia—Azerbaijan. **Wood.**

Trade of Azerbaijan for the year 1898–99. Foreign Office, Annual No. 2291, 1899. Size 10 × 6½, pp. 14. *Price* 1*d.*

Persia—Ispahan. **Preece.**

Trade of Ispahan and District for the years 1897–98 and 1898–99. Foreign Office, Annual No. 2260, 1899. Size 10 × 6½, pp. 22. *Price* 1½*d.*

The report bears witness to the disorganized state of Persia, and the difficulties which are experienced by foreign merchants.

Philippine Islands. *Quarterly Rev.* **190** (1899): 198–220. ———

The Philippines and their Future.

Philippine Islands. *National G. Mag.* **10** (1899): 271–272. ———

Meteorology in the Philippines.

The official meteorological observer at Hongkong complained to the American authorities of the Philippines because the Jesuit observatory at Manila telegraphed warnings of typhoons to Hongkong. This, it appears, was held to be contrary to international courtesy, which forbids a scientific institution to predict storms in any country except that in which it is situated; and the Jesuits were accordingly forbidden to announce the routes of approaching typhoons in Hongkong and Singapore.

Philippine Islands. *Rev. Française* **24** (1899): 344–352. **Lasalle.**

Philippines: L'insurrection de 1896–1897. Par C. de Lasalle. *With Map.*

Philippine Islands. *P.R. Artillery I.* **26** (1899): 309–320. **Simonds.**

Manila under the Americans. By Captain C. B. Simonds, R.A. *With Map.*

Philippine Islands. **Sonnenburg.**

M. Deutsch. Ges. Natur- u. Völkerk. Ostasiens **7** (1899): 285–292.

Stimmungsbilder aus Manila. Von Major Falkner von Sonnenburg.

A graphic description of the capture of Manila, told by a German military officer.

Russia—Caspian Sea. *Globus* **76** (1899): 13–17. **Seidlitz.**

Der Karabugas-Meerbusen des Kaspischen Meeres, nach den Ergebnissen der vom Ministerium der Landwirtschaft ausgesandten Expeditionen. Von N. v. Seidlitz. *With Map.*

Russia—Central Asia. *Petermanns M.* **45** (1899): 125–126. **Friederichsen.**

Meteorologische Beobachtungen in Luktschun, Zentralasien. Von Dr. M. Friederichsen.

Russia—Central Asia. *Imp. and Asiatic Quarterly Rev.* **7** (1899): 114–125. **Parker.**

Khokand and China. By E. H. Parker.

Russia—Siberia. ———

Travaux de la Sous-Section Troitzkossawsk-Kiakhta Section du pays d'Amour de la société Imperiale Russe de Géographie. Tome i. livraisons 1 and 2. 1898. [In Russian.] Moscow, 1899. Size 10 × 7, pp. (liv. 1) 82; (liv. 2) 78. *Plates.*

Russia—Siberia. *J.R. United Service I.* **43** (1899): 543–549. **Havelock.**

The Trans-Baikal. Translated from the 'Voïennyi Sbórnik.' By H. Havelock.

On the means of communication and climate of the Trans-Baikal territory.

Russia—Siberia. *Ymer* **19** (1899): 147–157. **Nilsson.**

Om de växtgeografiska och botaniska arbetena under Andrée-efterforskningsexpeditionen till Sibirien 1898. Af N. Herm. Nilsson. *With Illustrations.*

On the botanical observations made during the Andrée search expedition in Siberia.

Russia—Siberia. *Ymer* **19** (1899): 117–146. **Stadling.**

Efterforskningarna efter Andrée-expeditionen i Sibirien. Af J. Stadling. *With Map and Illustrations.*

On the journey through Northern Siberia from the Yenesei to the Lena delta in search of news of Andrée's expedition.

Russia—Transcaspian. *Scottish G. Mag.* **15** (1899): 356–361. ———

The Transcaspian Desert.

Russian Central Asia. *Deutsche G. Blätter* **22** (1899): 124–133. **Rickmers.**

Die Barren der Danduschka. Von Willy Rickmer Rickmers. *With Illustrations.*

Description of some peculiarities in the physical geography of the mountains and valleys in Bokhara.

Siam. *Imp. and Asiatic Quarterly Rev.* **7** (1899): 76–91. **Barrett.**

Siam and its neighbours. By the Hon. John Barrett.

Turkey—Palestine. *Palestine Exploration Fund, Q. Statement* (1899): 188–199. **Bliss.**

First Report of the Excavations at Tell-es-Sâfi. By F. J. Bliss, PH.D. *With Plan and Illustration.*

Turkey—Palestine. *Palestine Exploration Fund, Q. Statement* (1899): 170–187. **Bliss.**

Third Report on the Excavations at Tell Zakarîya. By F. J. Bliss, PH.D. *With Plan and Sections.*

Turkey—Syria. **Drummond-Hay.**

Trade of Beirut and the Coast of Syria for the year 1898. Foreign Office, Annual No. 2286, 1899. Size 10 × 6¼, pp. 20. *Price* 1½*d.*

Discusses the cause of the steady decline of the trade of the port of Beirut and of the railway from Beirut to Damascus. The construction of the railway from Haifa to Damascus is proceeding.

Turkey—Syria. **Richards.**

Trade of Damascus for the year 1898. Foreign Office, Annual No. 2306, 1899. Size 10 × 6, pp. 16. *Price* 1*d.*

Gives some particulars as to the Damascus-Hauran and the Damascus-Beirut railways.

AFRICA.

Algerian Sahara. *A travers le Monde, Tour du Monde* **5** (1899): 221–223. **Combes.**

La Question du Transsaharien. Par Paul Combes. *With Map.*

British South Africa. ———

Rhodesia.—(1889–1899). London: Simpkin & Co. Size 7½ × 9½, pp. vi. and 52. *Maps and Illustrations. Price* 1*s. Presented by the British South Africa Company.*

A collection of photographs of British South Africa, illustrative of the resources and progress of the territory.

British South Africa—Rhodesia. **Brown.**

On the South African Frontier: the Adventures and Observations of an American in Mashonaland and Matabeleland. By William Harvey Brown. London: Low & Co., 1899. Size 8½ × 6, pp. xxii. and 430. *Maps and Illustrations. Price* 12*s.* 6*d. Presented by the Publishers.*

The early chapters of this book deal with a scientific excursion to various ports in West Africa, but the bulk of the work is occupied by experiences in Rhodesia during the Matabele war. The author is an American, but took an active part against the rebellious natives, and gives his views as to the future of the country.

Cape Verd Islands. *B.S.G. Italiana* **12** (1899): 302–312. **Fea.**

Dalle Isole del Capo Verde. Del Leonardo Fea. *With Illustrations.*

Congo. *B.S.G. Rochefort* **21** (1899): 38–49. **Besson.**

Ma captivité chez les nègres du Congo (Mars à Juin 1792). Par M. Besson.

Egyptian Sudan. *Scottish G. Mag.* **15** (1899): 480–483. **Milne.**

Notes from the Equatorial Province. By A. D. Milne.

French West Africa. *B. Comité l'Afrique Française* **9** (1899): 293–298. **Maclaud.**

A travers la Guinée et la Fouta-Diallon: La mission Maclaud. *With Portrait and Map.*

French West Africa. *Rev. Française* **24** (1899): 587–591. **Montell.**
La Région Française du Tchad. Par M. A. Montell.

German East Africa. *Deutsches Kolonialblatt* **10** (1899): 124–131. ——
Bericht über eine Expedition nach Magalla, Ntusu, Nassa, Uschaschi bis zum 1. Grad südlicher Breite.

German East Africa. *Deutsches Kolonialblatt* **10** (1899): 6–12. ——
Bericht über einen Zug nach Ruanda.

German East Africa. *M. Deutsch. Schutzgeb.* **12** (1899): 168–173. **Herrmann.**
Der geologische Aufbau des deutschen Westufers des Victoria-Nyansa. Von Hauptmann Herrmann. *With Map.*

North-East Africa. *B.S. Khédiv. G.* **5** (1899): 133–161. **Castro.**
De Zeilah au Harar. Notes de voyage du Dr. Lincoln de Castro.
The expedition left Zeila in October, 1896.

Portuguese East Africa. **Belcher and Greville.**
Trade of Mozambique and Quilimane for the year 1898. Foreign Office, Annual No. 2221, 1899. Size 9½ × 6¼, pp. 14. *Price* 1*d.*

Portuguese East Africa. **Ross.**
Trade of Lourenço Marques and District for the year 1898. Foreign Office, Annual No. 2235, 1899. Size 9½ × 6, pp. 28. *Price* 2*d.*

Sierra Leone. *J.R. United Service I.* **43** (1899): 534–542. ——
The Sierra Leone Protectorate Expedition, 1898–1899. By one who was there. *With Sketch-maps.*

Tripoli. **Dickson.**
Trade of Tripoli for the year 1898. Foreign Office, Annual No. 2273, 1899. Size 10 × 6¼, pp. 12. *Price* 1*d.*

Tunis. **Johnston.**
Trade and General Progress in Tunis during the year 1898–99. Foreign Office, Annual No. 2279, 1899. Size 10 × 6¼, pp. 24. *Plan. Price* 1½*d.*

Uganda—Railway. ——
Report by the Mombasa-Victoria (Uganda) Railway Committee, on the Progress of the Works, 1898–99. London: Eyre & Spottiswoode, 1899. Size 13½ × 8½, pp. 18. *Map. Price* 8½*d.*

NORTH AMERICA.

Alaska. *National G. Mag.* **10** (1899): 281–288. **Stanley-Brown.**
Shishaldin as a Field for Exploration. By Joseph Stanley-Brown. *With Sketch-map and Illustrations.*
A note on this paper will appear in the *Journal.*

Alaska Boundary. *Globus* **76** (1899): 105–109. ——
Die zwischen England und den Vereinigten Staaten streitige Alaska-Grenzfrage. *With Illustrations.*

Canada—British Columbia. *Scottish G. Mag.* **15** (1898): 449–462. **Begg.**
Vancouver Island, B.C. By Alexander Begg.

Canada—Sable Island. *Nautical Mag.* **68** (1899): 563–567. **Small.**
To utilize Sable Island. By H. B. Small.
On a proposal to connect Sable island and the mainland of Nova Scotia, 85 miles distant, by Marconi's wireless telegraphy.

Canada—Yukon. **Heilprin.**
Alaska and the Klondike. A Journey to the new Eldorado, with Hints to the Traveller, and Observations on the Physical History and Geology of the Gold Regions, the Condition of and Methods of Working the Klondike Placers, and the Laws governing and regulating Mining in the North-West Territory of Canada. By Angelo Heilprin. New York: D. Appleton & Co.; London: C. Arthur Pearson, Limited. 1899. Size 8 × 5¼, pp. x. and 316. *Map and Illustrations. Price* 7*s.* 6*d. Two copies, one presented by the Author, the other by C. Arthur Pearson, Limited.*

A work on Alaska and the Klondike region by so well-known and experienced a traveller as Prof. Heilprin is necessarily of very special value. The visit described

occupied from July to October, 1898, the journey being by the White pass down the upper Yukon to Dawson, and the return was by the Chilkoot Pass, so that practically the whole book applies to the Canadian Yukon. The regulations as to gold-mining and the nature and method of working the mines are fully described.

United States—Illinois. **Wyndham.**

Trade of Chicago and District for the Year 1898. Foreign Office, Annual No. 2239, 1899. Size 9½ × 6½, pp. 36. *Price* 2½*d.*

The curious fact is pointed out in this report that Chicago is now the busiest port in the United States, as estimated both by number of vessels and tonnage entered and cleared; the number of entries in 1898 being 9575 compared with 7305 for New York, and 1056 for San Francisco.

United States—Illinois. **Leverett.**

The Pleistocene Features and Deposits of the Chicago Area. By Frank Leverett. The Chicago Academy of Sciences. Bulletin No. II. of the Geological and Natural History Survey, 1897. Size 9½ × 6½, pp. 86. *Map and Illustrations. Presented by the Chicago Academy of Sciences.*

United States—Maryland. **James.**

The Labadist Colony in Maryland. By Bartlett B. James, PH.D. Johns Hopkins University Studies in Historical and Political Science. Series xvii. No. 6. Baltimore, 1899. Size 10 × 6½, pp. 46.

The Labadists were a Dutch sect who emigrated to Maryland in the early part of the seventeenth century in order to practise their tenets in peace.

United States—Michigan. *American J. Sci.* **6** (1899): 31–34. **Mudge.**

Mouth of Grand River. By E. H. Mudge.

On some interesting relations of the glacial valley of Grand river, Michigan, to its present mouth.

United States—Montana. *B. American G.S.* **31** (1899): 199–216. **Kimball.**

The Granites of Carbon County, Montana: A Division and Glacier Field of the Snowy Range. By James P. Kimball. *With Sketch-map and Plates.*

United States—New York. *B. Geolog. S. America* **9** (1898): 183–210. **Brigham.**

Topography and Glacial Deposits of Mohawk Valley. By Albert Perry Brigham. *With Maps.*

United States—New York State. *B. American G.S.* **31** (1899): 217–235. **Tarr.**

Physical Geography of New York State. By Ralph S. Tarr. Part viii.—The Great Lakes and Niagara. *With Maps.*

United States—Oregon, Idaho, and Washington. ———

Trade of the States of Oregon, Idaho, and Washington for the year 1898. Foreign Office, Annual No. 2295. 1899. Size 10 × 6½, pp. 48. *Price* 2½*d.*

CENTRAL AND SOUTH AMERICA.

Andes. *Alpine J.* **19** (1899): 509–523. **Conway.**

Climbs in the Andes in 1898. By Sir Martin Conway. *With Illustrations.*

Argentine Republic. *B.A. Nac. Ci. Cordoba* **16** (1899): 33–48. **Doering.**

Resultados Hipsométricos de Algunos Viajes del Doctor G. Bodenbender calculados por Oscar Doering.

On the altitudes determined by Dr. Bodenbender and particulars as to the aneroids he employed.

Argentine Republic—Cordoba. *B.A. Nac. Ci. Cordoba* **16** (1899): 49–115. **Doering.**

De Soto á Villa Mercedes. Determinaciones barométricas de alturas por Oscar Doering.

Argentine Republic—Cordoba. *B.A. Nac. Ci. Cordoba* **16** (1899): 5–32. **Doering.**

Alturas. Tomadas en la provincia de Córdoba. Por Oscar Doering.

On the determination of altitudes in the province of Cordoba.

Brazil. *Export* **21** (1899): 346, 347, 355, 356. ———

Die Bahnen Neu-Hamburg—Caxias und Neu-Hamburg—Torres. (Originalbericht aus Südbrasilien.)

Brazil. *J. Manchester G.S.* **14** (1898): 321–354. **Boraston.**

Brazil in 1898. By John Maclair Boraston.

Brazil—Amazonas. **Nery.**

Le Pays des Amazones, l'El-Dorado, les Terres à Caoutchouc. Par le Baron de Santa-Anna Nery. Paris: Guillaumin et Cie., 1899. Size 11 × 7½, pp. xxxvi. and 420. *Map and Illustrations. Presented by the Author.*

A new edition of a work which appeared originally in 1884, taking account of the vast advances which have been made in the province of Amazonas in consequence of the development of the indiarubber trade and from other causes.

Brazil—Para. **Santa Rosa and Fidanza.**

Album do Pará em 1899. Parte descriptiva do Dr. Henrique Santa Rosa, Photographias e composição de F. A. Fidanza. Size 16½ × 12, pp. 160. *Maps and Illustrations. Presented by the Brazilian Minister.*

A large selection of views of the province of Para, with official statistics. The text is given in Portuguese, Italian, and German.

Chile. *B.S.G. Paris* **18**, 1897 (1899): 473–495. **Latrille.**

Notice sur le territoire compris entre Pisagua et Antofagasta, avec la région des hauts plateaux boliviens. Par M. Roch Latrille. *With Map.*

Patagonia. *B.S.G. Com. Paris* **20** (1898): 626–643. **Vaulx.**

A travers la Patagonie, du Rio Negro au détroit de Magellan. Par M. Henry de la Vaulx.

Peru. *B.S.G. Lima* **7** (1898): 441–464; **8** (1898): 62–81. **Basadre.**

Provincia de Yauyos. Por el Ingeniero Ricardo Rey y Basadre.

Peru. *B.S.G. Lima* **8** (1898): 81–104. **Osambela.**

Diccionario Oriental del Perú. Por el doctor Claudio Osambela.

Peru. *B.S.G. Lima* **8** (1898): 1–62. **Raimondi.**

Itinerario de los viajes de Raimondi en el Perú: Cuzco., Valle de Lares, Santa Ana y regreso por Mollepata y Limatambo (1865).

Peru. **St. John.**

Trade and Finances of Peru for the year 1898. Foreign Office, Annual No. 2298, 1899. Size 10 × 6½, pp. 34. *Price* 2½*d.*

A new cart-road is being constructed for 90 miles, from Cuzco along the valley of the Vilcanota to Sicuani, and is already opened for traffic halfway.

AUSTRALASIA AND PACIFIC ISLANDS.

Australia—Discovery. **Heeres.**

The Part borne by the Dutch in the Discovery of Australia, 1606–1765. By J. E. Heeres, LL.D. Published by the Royal Dutch Geographical Society in commemoration of the Twenty-fifth Anniversary of its Foundation. London: Luzac & Co., 1899. Size 14 × 10, pp. xviii. and 106. *Maps. Presented by the Royal Dutch Geographical Society.*

On the part played by Dutch navigators in the discovery of Australia.

British New Guinea—Vegetation. *P.R.S. Queensland* **14** (1899): 14–20. **Bailey.**

Notes on the Vegetation of New Guinea. By F. Manson Bailey.

Caroline Islands. *G.Z.* **5** (1899): 545–562. **Kirchhoff.**

Umrisse zu einer Landeskunde der Karolinen. Von Prof. Dr. A. Kirchhoff.

Caroline Islands. *Globus* **76** (1899): 37–52. **Singer.**

Die Karolinen. Von H. Singer. *With Maps and Illustrations.*

German New Guinea. *Deutsche Kolonialzeitung* **16** (1899): 245–428. ——

Ueber Kaiser-Wilhelmsland. *With Illustrations.*

New South Wales. **Bladen.**

Historical Records of New South Wales. Vol. vi. King and Bligh, 1806, 1807, 1808. Edited by F. M. Bladen. Sydney, 1898. Size 9 × 6, pp. lxxvi. and 876. *Maps, Portraits, and Illustrations. Presented by the New South Wales Government.*

This volume deals with the important period of the governorships of King and Bligh, and is illustrated with reproductions of coloured prints and a number of facsimile letters.

Society Islands. **Simons.**

Trade of the Society Islands for the year 1898. Foreign Office, Annual No. 2293, 1899. Size 9½ × 6½, pp. 10. *Price* ½*d.*

South Australia—Tides. **Chapman and Inglis.**

Rep. Australasian Assoc. **7** (1898): 241–244.

The Tides of South Australia. By R. W. Chapman, M.A., and Captain A. Inglis. *With Diagram.*

Tonga. **Leefe.**

Trade of Tonga for the year 1898. Foreign Office, Annual No. 2267, 1899. Size 10 × 6½, pp. 8. *Price* ½*d.*

Victoria. ———

Abstract of the Statistics of Victoria 1893 to 1898. Melbourne. Size 8½ × 5½, pp. 38.

Victoria—Cloud Observations. *Rep. Australasian Assoc.* **7** (1898): 259–265. **Baracchi.**

Cloud Observations in Victoria. By P. Baracchi, F.R.A.S. *With Plates.*

Western Australia. **Blatchford.**

Western Australia: Geological Survey. Bulletin No. 3. The Geology of The Coolgardie Goldfield. By Torrington Blatchford. Perth, 1899. Size 8½ × 5½, pp. 98. *Map and Diagram. Presented by the Government Geologist, W. Australia.*

This report contains a geological map showing the gold workings and wells.

Western Australia—Botany. *J. Linnean S., Botany* **34** (1899): 171–261. **Moore.**

The Botanical Results of a Journey into the Interior of Western Australia. By Spencer Le Marchant Moore.

POLAR REGIONS.

Antarctic. *National G. Mag.* **10** (1899): 316–319. **Grosvenor.**

Plans for reaching the South Pole. By Gilbert H. Grosvenor. *With Map.*

Antarctic. *L'Esplorazione Com.* **14** (1899): 20–23, 122–125, 157–159, 186–189. **Pini.**

Spedizioni polari antartiche. E. Pini.

Antarctic—Drift-ice. *Ann. Hydrographie* **27** (1899): 398–402. **Dinklage.**

Treibeis in südlichen Breiten. Von L. E. Dinklage.

Antarctic—Historical. *T.R.G.S. Australasia (Victoria)*: **16** (1898); 15–27. **Morris.**

Terra Australis Incognita. By Prof. Morris, LITT.D. *With Facsimile Maps.*

Greenland and Iceland. ———

Meteorologiske Middeltal og Extremer for Færøerne, Island og Grønland. Eléments météorologiques des îles Féroé, de l'Islande et du Groenland. Appendix til det danske meteorologiske Instituts Aarlog 1895, II. Del. Kjøbenhavn, 1899. Size 10½ × 8½, pp. 30. *Map. Presented by the Danske Meteorologiske Institut.*

MATHEMATICAL GEOGRAPHY.

Latitude Determinations. *Ann. Hydrographie* **27** (1899): 413–418. **Fulst.**

Ueber das sogenannte "Pagelsche Verfahren." Von Dr. O. Fulst.

Nautical Astronomy. *Nautical Mag.* **68** (1899): 526–540. **Goodwin.**

The Simplification of Formulæ in Nautical Astronomy. By H. B. Goodwin.

Time and Longitude. *Rev. Française* **24** (1899): 576–586. **Cugnin.**

L'Heure et la Longitude Universelles. Par M. E. Cugnin.

Time and Prime Meridian. *Riv. G. Italiana* **6** (1899): 457–480. **Rajna.**

Una discussione su l'unificazione del calendario: il meridiano iniziale per le longitudini e l'ora universale. [Michele Rajna.]

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Lakes. *J.G. Tokyo G.S.* **11** (1899): 275–291, 378–387. **Tanaka.**

Temperature of Lakes and their Classification. By Akamaro Tanaka. [In Japanese.]

Meteorology. **Davis.**

The Circulation of the Atmosphere. By Prof. William Morris Davis. (From the *Quarterly Journal of the Royal Meteorological Society*, vol. XXV. No. 110, April, 1899.) Size 10 × 6½, pp. [10]. *Presented by the Author.*

Meteorology—Conference. ——

Proceedings of the Convention of Weather Bureau Officials, held at Omaha, Nebr, October 13–14, 1898.—U.S. Department of Agriculture. Weather Bureau. Bulletin No. 24. Washington, 1899. Size 9 × 6, pp. 184. *Illustration.*

This conference dealt with a number of topics relating to weather prediction and practical meteorology.

Mountain-structure. *G.Z.* **5** (1899): 563–579. **Frech.**

Ueber die Gebirgsbildung im paläozoischen Zeitalter. Von Prof. Dr. Fritz Frech. *With Plate.*

Oceanographical Apparatus. *C. Rd.* **129** (1899): 243–245. **Charbonnier and Galy-Aché.**

Sur un bathymètre fondé sur l'emploi de cylindres crushers. Note de MM. Charbonnier et Galy-Aché.

Oceanography. *Z. Ges. Erdk. Berlin* **34** (1899): 75-192. **Chun, Schott, and Sachse.**

Die Deutsche Tiefsee-Expedition. A. Berichte des Leiters der Expedition Prof. Dr. Chun. B. Berichte des Oceanographen der Expedition Dr. Gerhard Schott. C. Bericht des Navigations-Offiziers der Expedition Walter Sachse. *With Maps, Diagrams, etc.*

Oceanography. *Scottish G. Mag.* **15** (1899): 416–421. ——

The Effect of Ice-melting on Oceanic Circulation.

Oceanography. *C. Rd.* **129** (1899): 9–15. **Gautier.**

Examen de l'eau de mer puisée à différentes profondeurs; variations de ses composés iodés. Note de M. Armand Gautier.

Oceanography. **Murray.**

On the Temperature of the Floor of the Ocean and of the Surface Waters of the Ocean. By Sir John Murray, K.C.B., F.R.S., etc. From the *Geographical Journal* for July, 1899. Size 10 × 6½, pp. 18. *Maps.*

Oceanography. **Natterer and Pott.**

Berichte der Commission für oceanographische Forschungen. Expedition S.M. Schiff "Pola" in das Rothe Meer, Nördliche Hälfte (Octobre 1895—Mai 1896) IX. Chemische Untersuchungen ausgeführt von Dr. Konrad Natterer. Wien: Carl Gerold's Sohn, 1898. Size 12½ × 10, pp. 128. *Maps and Illustrations. Presented by the Author.*

Ditto: Beschreibender Theil, verfasst von Paul Edler von Pott. Wien: C. Gerold's Sohn, 1898. Size 12 × 9½, pp. 56. *Maps and Illustrations. Presented by the K. Akademie der Wissenschaften, Wien.*

Oceanography. *Ann. Hydrographie* **27** (1899): 274–276. **Schott.**

Nachtrag zu Heft V. (Seite 227 bis 236). Dr. Schott: von der deutschen Tiefsee-Expedition. *With Diagram.*

Dr. Schott gives a table comprising all the soundings of the *Valdivia* expedition, with the positions and bottom temperatures, a selection of some of the more interesting serial temperature-soundings, and a curve showing the typical antarctic and tropical vertical distribution of temperature.

Oceanography. ——

The Danish Ingolf-Expedition. Vol. i. part i.—(1) C. F. Wandel: Report of the Voyage; (2) Martin Knudsen: Hydrography. Vol. ii. part i.—(1) Chr. Lütken: The Ichthyological Results; (2) Hector F. E. Tungersen: On the Appendices Genitales (Claspers) in the Greenland Shark, *Somniosus microcephalus* (Bl. Schn.), and other Selachians. Vol. iii. part i.—Fr. Meinert: Pycnogonida. Published . . . by the direction of the Zoological Museum of the University. Copenhagen: H. Hagerup, 1899. Size 13½ × 10½, pp. (i. 1) 162; (ii. 1) 40 and 88; (iii. 1) 72. *Maps and Plates. Presented by the Zoological Museum, Copenhagen.*

Oceanography—Fisheries. **Lavieuville and Pérard.**

Congrès International de Pêches Maritimes d'Ostréiculture et d'Aquiculture marine réuni à Dieppe du 2 au 6 Septembre, 1898. Par l'Enseignement professionnel et technique des Pêches Maritimes avec le concours du Département, de la Ville et de la Chambre de Commerce de Dieppe. Comptes Rendus des Séances publiés par les secrétaires généraux Gustave Lavieuville et Joseph Pérard. Paris: A. Challamel, 1899. Size 10 × 6½, pp. xxviii. and 434. *Illustrations. Presented by O. T. Olsen, Esq.*

Mr. Olsen attended the International Fisheries Congress as representative of the Royal Geographical Society. Some of the articles are specially noticed.

Oceanography—Marine Fauna. **Thompson.**

On a supposed Resemblance between the Marine Faunas of the Arctic and Antarctic Regions. By D'Arcy Wentworth Thompson, C.B. Reprinted from the *Proceedings of the Royal Society of Edinburgh*. 1898. Size 9 × 5½, pp. 311–349. *Presented by the Author.*

Prof. D'Arcy Thompson here states the case against the assumption that the identity of arctic and antarctic faunas is striking enough to require a theoretical explanation.

Oceanography—North Sea. **Buchan.**

Tidal Currents of the North Sea. By Alexander Buchan, LL.D., F.R.S. Reprinted from the *Proceedings of the Royal Society of Edinburgh*. 1899. Size 9 × 5½, pp. [4]. *Presented by the Author.*

Oceanography—Pacific Ocean. *Science* **9** (1899): 796–798. **Smith.**

Exploring Expedition to the mid-Pacific Ocean. By Dr. Hugh M. Smith.

This is noticed in the *Journal* for July, p. 96.

Seismology. *Atti R.A. Lincei, Rendiconti* **8** (1899): 3–12. **Riccò.**

Riassunto della sismografia del terremoto del 16 novembre 1894. Parte 1ª. Intensità linee isosismiche, registrazioni strumentali. Nota del Corrispondente A. Riccò. *With Map.*

Terrestrial Magnetism. **Bauer.**

Vertical Earth-Air Electric Currents. By L. A. Bauer. From *Terrestrial Magnetism*, March, 1897. Size 9½ × 7, pp. 11–22. *Presented by the Author.*

Terrestrial Magnetism. *Atti R.A. Lincei, Rendiconti* **8** (1899): 529–534. **Bellagamba.**

Sull' influenza della pressione barométrica nelle determinazioni della componente orizzontale del magnetismo terrestre. Nota del dott. G. Bellagamba.

On the influence of barometric pressure in determining the horizontal component of magnetic force.

Terrestrial Magnetism. *Terrestrial Magnetism* **4** (1899): 105–112. **Eschenhagen.**

Ueber einige Probleme des Erdmagnetismus und die Nothwendigkeit einer Internationalen Organisation. Von M. Eschenhagen.

Terrestrial Magnetism. *Terrestrial Magnetism* **4** (1899): 113–129. **Rücker.**

The Secondary Magnetic Field of the Earth. By A. W. Rücker.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Anthropogeography. **Herbertson.**

Man and his Work, an Introduction to Human Geography. By A. J. Herbertson, PH.D., and F. D. Herbertson, B.A. London: A. and C. Black, 1899. Size 7 × 5, pp. viii. and 118. *Price* 1*s.* 6*d.* *Presented by the Publishers.*

In this little book Dr. and Mrs. Herbertson present in a popular form the principles of Anthropogeography, laying stress on the influence of geographical environment on the manner of life and political organization of the races of mankind.

Anthropology—Jews. *Globus* **76** (1899): 21–27. **Ripley.**

Ripley über die Anthropologie der Juden. *With Illustrations.*

Historical *T.R.G.S. Australasia* (*Victoria*) **16** (1898): 28–37. **Wright.**

Vasco da Gama and his Companions; and Discoveries by the Portuguese in Asia and Africa. By A. J. Wright.

Historical—Ancient Greeks. *B.S.G. Madrid* **41** (1899): 129–155. **Garofalo.**

Estudios de Historia griega. Por Francesco P. Garofalo. El Occidente según los antiguos escritores griegos.

On the knowledge of Western countries possessed by the ancient Greeks.

BIOGRAPHY.

Howell. *Geolog. Mag.* **6** (1899): 433–437. ——

Eminent Living Geologists: Henry H. Howell, F.G.S., formerly Director of the Geological Survey of Great Britain. *With Portrait.*

Neumayer. *Terrestrial Magnetism* **4** (1899): 203.

Biographical Sketch of Prof. George Neumayer. *With Portrait.*

Odierna. **Licitra.**

Dott. Angelo Licitra. Studio su la Vita e su le Opere di Giovanni-Battista Odierna, Astronomo-Matematico e Naturalista Ragusano. Ragusa, 1899. Size 9½ × 6, pp. 184. *Portrait. Presented by the Author.*

The mathematician and astronomer Odierna was born at Ragusa in 1597, and died in 1660. A bibliography of his writings and those of commentators is given, extending from the year 1628 to 1882, and comprising 63 entries.

Pomba.

Pio Ricordo di Cesare Pomba. Size 10 × 6½, pp. 32. *Portrait and Map. Presented by Madame Pomba.*

GENERAL.

Applied Geography. *J. Manchester, G.S.* **14** (1898): 264–285. **Herbertson.**

Report on the Teaching of Applied Geography. By Dr. A. J. Herbertson.

Bibliography of Geography. **Raveneau.**

Bibliographie géographique annuelle, 1898.—Annales de Géographie, No. 41, 8ᵉ Année, 15 Septembre 1899. Paris: A. Colin et Cie. Size 10 × 6½, pp. 304.

This admirable bibliography keeps up its character for careful selection and terse characterization of the geographical work of the preceding year.

Educational. *J. Manchester G.S.* **14** (1898): 286–292. **Herbertson.**

The Position of Economic Geography in Education. By Dr. A. J. Herbertson.

Educational. *Rev. Scientifique* **12** (1899): 236–241. **Picard.**

L'enseignement rationnel de la géographie. Par M. E. Picard.

Refers mainly to Prof. de Lapparent's views.

Geographical Exhibition. *Ric. G. Italiana* **6** (1899): 14, 119, 222, 368, 422. **Frescura.**

La Geografia all' Esposizione di Torino pel Prof. Bernardino Frescura.

Health – Scurvy. **Beadnell.**

On the Decline of Scurvy afloat. Being a Paper read before the Hong Kong Branch of the British Medical Association, February, 1899. By Surgeon C. Marsh Beadnell, R.N. Size 8¼ × 5¼, pp. 16. *Presented by the Author.*

The author points out that the cause of scurvy is the reduced alkalinity of the blood, and shows that the effect of fresh vegetables or freshly killed meat is to increase the alkalinity and remove the conditions of the disease. In the arctic regions fresh meat has this effect long after it has been killed, on account of the preservative effect of low temperature.

Irrigation. *Science* **9** (1899): 798–799. **True.**

The Scientific Study of Irrigation. By Dr. A. C. True.

Missionary Reports.

Report of the year 1898 of the Society for the Propagation of the Gospel in Foreign Parts. London, 1899. Size 8¼ × 5¼, pp. 218. *Maps.*

This report contains a map of the world, showing the Anglican missionary dioceses of the English and American churches.

Oriental Literature. **Müller**

The Sacred Books of the East, . . . edited by F. Max Müller. Vols. 43 and 47. Oxford: the Clarendon Press, 1897. Size 9 × 6, pp. (vol. 43) xxviii. and 410; (vol. 47) xlviii. and 186. *Presented by the Secretary of State for India.*

Polynesian Geography. *Rep. Australasian Assoc.* **7** (1898): 801–816. **Smith.**

The Geographical Knowledge of the Polynesians. By S. Percy Smith. Part ii. *With Map.*

Southampton Geographical Society.

Southampton Geographical Society's Report, 1898. Southampton, 1899. Size 8½ × 5½, pp. 32. *Map.*

NEW MAPS.

By J. COLES, *Map Curator*, R.G.S.

EUROPE.

England and Wales. **Ordnance Survey.**

Publications issued since September 8, 1899.

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(*E. Stanford, Agent.*)

Germany. **Königl. Preuss. Landes-Aufnahme.**

Karte des Deutschen Reiches. Herausgegeben von der Kartogr. Abtheilung der Königl. Preuss. Landes-Aufnahme, 1899. Sheets 283, Osnabrück: 285, Minden; 286, Hannover. Scale 1: 100,000 or 1·6 stat. mile to an inch. *Price* 1.50 *marks each sheet.*

AMERICA.

Suriname. **Loth.**

Kaart van Suriname. Naar de opmetingen van J. F. A. Cateau van Rosevelt en J. F. A. E. van Lansberge, aangevuld tot 1898 met die van—en geteekend door W. L. Loth, Gouvernements-Landmeter in Suriname. Eerbiedig opgedragen aan H. M. de Koningin der Nederlanden. Scale 1: 500,000 or 7·9 stat. miles to an inch. J. H. de Bussy, Amsterdam, 1899. *Presented by the Publisher.*

On this map are shown all means of communication, the agricultural conditions of the country, the character of the soil, and the general physical features.

GENERAL.

World. **Bartholomew.**

Bartholomew's Physical Atlas—Vol iii., Atlas of Meteorology. A series of over 400 maps, prepared by J. G. Bartholomew, F.R.S.E., and A. J. Herbertson, PH.D., and edited by Alexander Buchan, LL.D., F.R.S., under the patronage of the Royal Geographical Society. Prepared at the Edinburgh Geographical Institute, and published by Archibald Constable & Co., Westminster, 1899. *Price* £2 12*s.* 6*d.* *Presented by the Publishers, and by Messrs. J. Bartholomew & Co.*

This is the first issue of an important physical atlas in course of publication, of which it forms the third volume, and is in itself a complete meteorological atlas. It may be referred to with confidence on all subjects connected with the distribution of temperature, barometric pressure, clouds, sunshine, and rainfall, as well as matters

connected with winds and storms; much interesting information being given on these subjects.

The atlas contains more than four hundred beautifully executed maps, and, considering the vast amount of work entailed in the compilation, is remarkably cheap at the price at which it is offered to the public.

A separate notice of the important atlas of which this volume forms part, will be published in the *Geographical Journal*.

World. **Meyer.**

Meyer's Hand-Atlas. Zweite, neubearbeitete und vermehrte Auflage mit 112 Kartenblättern, 9 Textbeilagen und Register aller auf den Karten verzeichneten Namen. Parts 23 and 24 (in one) and 25 and 26 (in one). Leipzig und Wien. Verlag des Bibliographischen Instituts, 1899. *Price 60 pf. each issue.*

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, July and August, 1899. *Presented by the Hydrographic Department, Admiralty.*

No.	Inches.	
3061 to 3072		Tidal streams:—North sea. 4*d. each* The same twelve charts bound together in an atlas. 5*s.*
114c	m = 3·95	Scotland, east coast, River Forth:—Port Edgar to Carron river. 2*s.* 6*d.*
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3107	m = 0·25	Brazil, east coast:—Cape St. Thomé to Guaratiba point. 2*s.* 6*d.*
1309	m = var.	Plans on the east coast of Patagonia:—Port Desire, Port Desire with a sketch of the river, Port Gallegos anchorage, Port and river Gallegos, Sea Bear bay (reproduction). 1*s.* 6*d.*
3094	m = 1·7	Central America, west coast:—Jiquilisco bay (Port el Triunfo). 1*s.* 6*d.*
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3115	m = 1·95	Africa, west coast:—Forcados river entrance 1*s.* 6*d.*
3085	m = 7·85	Mauritius:—Tombeau and Arsenal bays. 1*s.* 6*d.*
3087	m = 7·85	Mauritius:—Black river bay. 1*s.* 6*d.*
3003	m = 0·15	Japan:—Ando Zaki to Otose Zaki, including Sado island (Plans:—Tobi Shima anchorage, Sakata harbour, Ogi bay, Kamo harbour, Niigata roadstead). 2*s.* 6*d.*
3097	m = {5·9 / 6·0}	Anchorages in the Friendly islands:—Neiafu anchorage and approaches, Ofolanga island and approaches. 1*s.* 6*d.*
3102	d = 2·6	Pacific Ocean:—Hawaii to the parallel of 6° 15′ N. 2*s.* 6*d.*
111		England, east coast:—Farn island to Berwick (New plan:—Holy island harbour).
48		British Columbia:—Skidegate inlet (Plans added:—Kitgoro, Kaisun harbour).
962		Ports in the Philippine islands:—New plan, Port Palanog.
2591		New Zealand:—River Waiau to Cape Foulwind (Plan added:—Westport harbour).

(*J. D. Potter, Agent.*)

Charts Cancelled.

No.		Cancelled by	No.
114c	River Forth. Queensferry to Stirling.	New chart. River Forth:—Port Edgar to Carron river	114c
2470	Connecticut river.	New sheet.	
2880	New Bedford harbour.	Plans on the east coast of North America	2470
1309	Plans on the east coast of Patagonia.	New sheet. Plans on the east coast of Patagonia . .	1309
536	Sado island.	New chart. Ando Zaki to Otose Zaki	3003

Charts that have received Important Corrections.

No. 1188, the World:—Coal and Telegraph chart. 2151, River Thames:—Broadness to Mucking Light. 109, England, east coast:—Entrance to the river

Humber. 1191, England, east coast:—Flamborough head to Hartlepool. 2046, Ireland, south coast:—Waterford harbour. 1972, Norway, west coast:—Approaches to Trondhjem, eastern sheet. 2309, Norway, west coast:—Leka to Donnesö. 810, Baltic sea:—Hangö road and approaches. 562, Spain, east coast:—Port of Valencia. 429, Corsica:—Cape Feno to Lava bay. 1942, Prince Edward island:—Bedeque harbour. 2961, Lake Ontario:—Eastern part of the bay of Quinté. 443, Cuba:—Port of Santiago de Cuba. 513, Venezuela:—Puerto Cabello, etc. 574, Chile:—Coquimbo bay and port Herradura. 1923A, British Columbia:—Cape Caution to Port Simpson, northern portion. 1923B, British Columbia:—Cape Caution to Port Simpson, southern portion. 2430, British Columbia:—Queen Charlotte islands. 1500, Alaska:—Kadiak island to Seguam island. 1562, Africa, west coast:—Rivers Nuñez and Componi. 2908, Africa, south coast:—Port Natal entrance. 734, Red sea:—Suez bay. 70, Bay of Bengal. 823, Bay of Bengal:—Koronge island to White point. 2413, China sea:—Rhio strait. 2577, Philippine islands:—Between St. Bernardino and Mindoro straits. 1395, China:—Tinghai harbour and approaches. 532, Japan:—Simonoseki strait. 2511, Russian Tartary:—Strelok bay to St. Vladimir bay. 1674, Australia, east coast:—Brisbane river. 960, Tasmania:—Approaches to Hobart. 2411, New Zealand:—Otago harbour from the entrance to Dunedin. 2421, South Pacific Ocean:—Tonga or Friendly islands.

(*J. D. Potter, Agent.*)

PHOTOGRAPHS.

Luchu Islands. **Clutterbuck.**

Forty-three Photographs of Great Luchu island, taken by W. J. Clutterbuck, Esq. *Presented by W. J. Clutterbuck, Esq.*

This is an interesting set of photographs representing the scenery, dwellings, and natives of the Luchu islands. The following is a list of the subjects:—

(1) One of the five entrances to Shuri Castle; (2) Bridge on the road to Shuri; (3) The first gate at Shuri; (4) The second gate at Shuri; (5) A shop in Shuri; (6) Leading pony to Shuri; (7) Bridge in front of Buddhist temple at Shuri; (8) Female worshippers at a shrine in Shuri; (9) Luchuan boy; (10) Native Luchuan boat; (11) A Luchuan tomb; (12) Luchu sail (made of reeds); (13) Ordinary Luchuan dwelling; (14–16) Luchuan tombs; (17) Native Luchuan ladies; (18) In the town of Naha; (19) Just off the market-place, Naha; (20) Native women in a street at Naha; (21) Leaving the port of Naha; (22) Street at Naha; (23) A woman at Naha; (24, 25) The road from Naha to Shuri; (26) Cast-away earthenware pots made at the potteries about 3 miles from Naha; (27) On the road from Naha to Shuri; (28) Three native children; (29) A native house; (30) Native women; (31) Laden native pony; (32) Our Japanese servant, Masuda, on his pony; (33) Sago palms (*Cycas revoluta*); (34) A native canoe, in which two natives will sometimes go out 20 miles to sea; (35) Two women; (36) Where native paper is made; (37) A coffin; (38) Aomori to be shipped for consumption in other islands of same group; (39, 40) The potteries; (41) Snake's skin (Habu snake) guitar, pewter pots for holding spirit at a funeral, horn spoon for wearing in ladies' hair during mourning, pieces of painted hand-made linen; (42) Gazimaru tree; (43) White glazed earthenware for putting the bones of a dead person in three years after burial.

Transylvania. **Lóczy.**

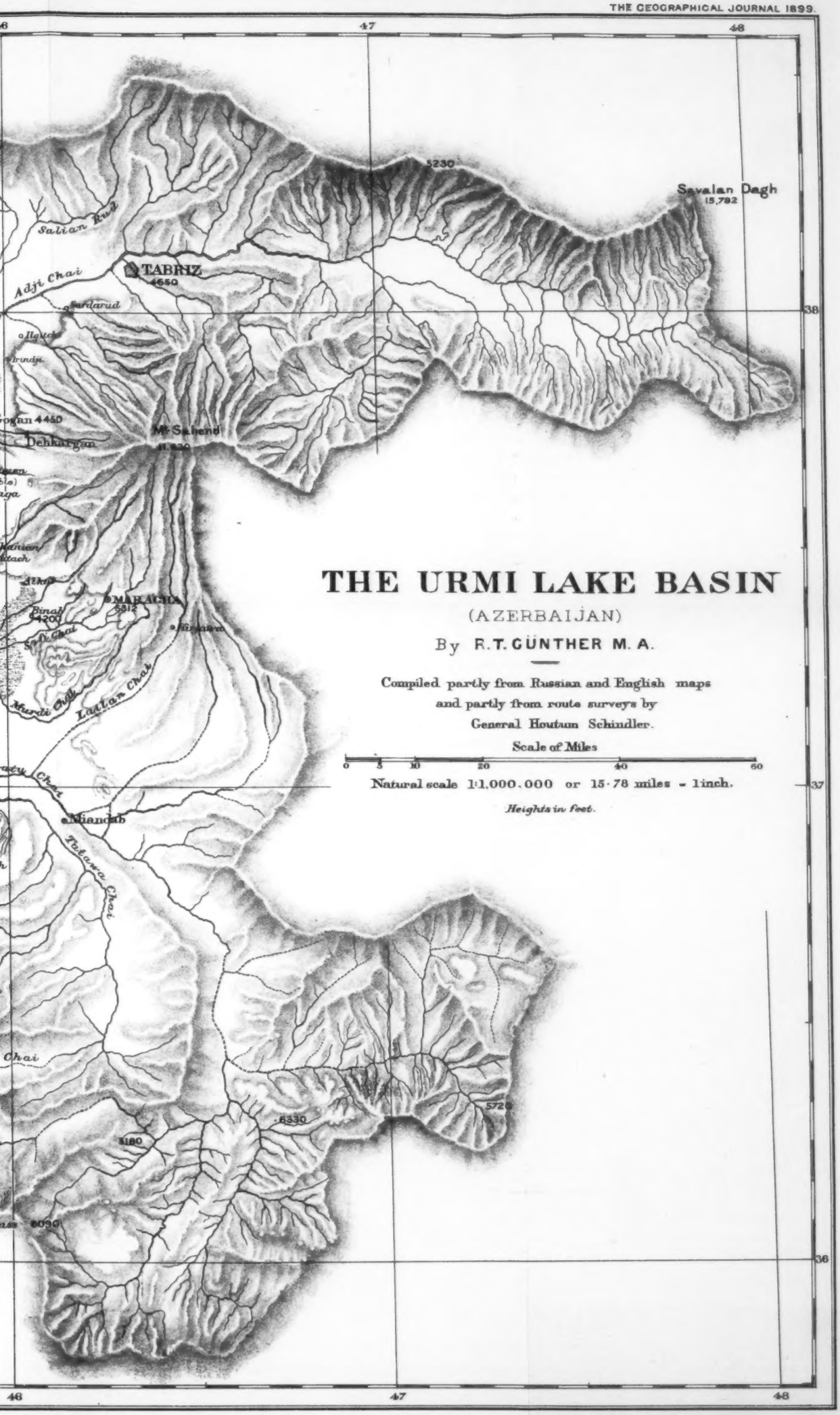
Five Photographs of Transylvania, taken by Dr. Lóczy, 1891. *Presented by Dr. Lóczy.*

(1) Greek Church of Demsus constructed from the remains of the Roman city of Ulpia-trajan; (2) The Andesite cone of the town of Diva, with ruins of the castle, the river Maros, and the mining hills of Nagyag in the background; (3) Gold-mines of Verespatok; (4) Andesite conglomerates with rain-marks, Josiashely, on the right bank of the river Fehir Korós; (5) Scenery in the South Transylvanian Carpathians, head of the valley of Toijecr, in the Paring group.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

45
46
38
37
Turesh
Salmas
6800
Dilimara
Plain of Salmas
Zola Chai
Ula 4550
Diriki
Warm Spring
Guvarchin Kala
4100
7900
Gavilan
Shahi Dagh
Superghan
Ganbul Dagh
or St George's Hill
TERGAWAR
Bahchi Kala
Gulmachana
Bezau Daghi
Namlis Ch.
Giamitchu ?
URMI
4343
Shahar Chai
Seir
Ardischai
Barendaz Chai
Shasalan I.
Arzu
Ispir
Ishak
Kizil Ruspur
Swiatt D.
Koyun D.
Jairu I.
Dekalar R.
Khanaga
Marble)
Usharu 5080
Gader Chai
Plain of Soldus
Ohsa
10.000
Sea of Sujbulak Chai
Dieghaty
Tatawa Cha
Pass
Suj bulak
4272
Map showing relations
of the
URMI LAKE BASIN.
Scale of Miles
0 100 200 300
40
45
50
35
30
36

Published



THE URMI LAKE BASIN

(AZERBAIJAN)

By R. T. GÜNTHER M. A.

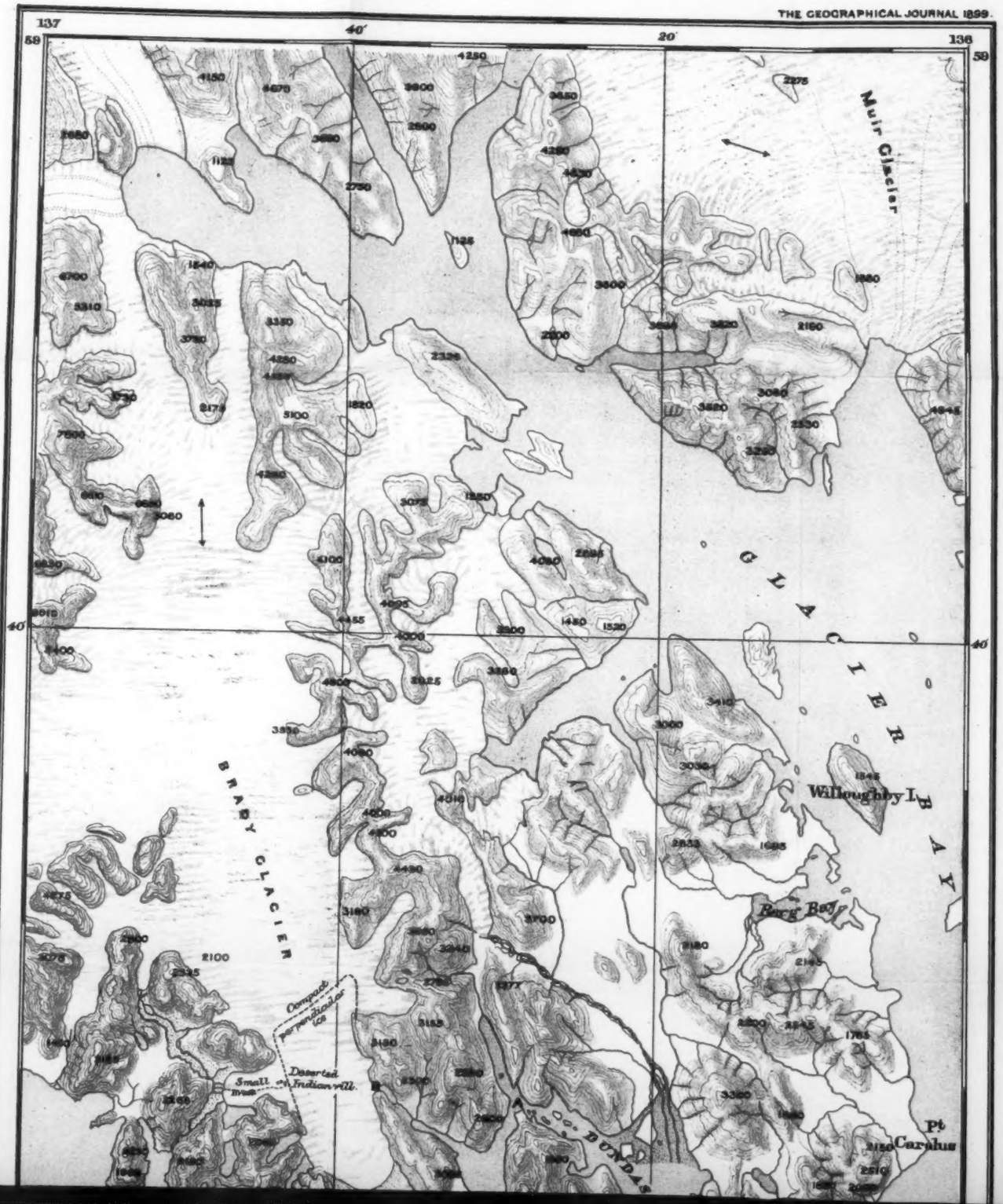
Compiled partly from Russian and English maps and partly from route surveys by General Houtum Schindler.

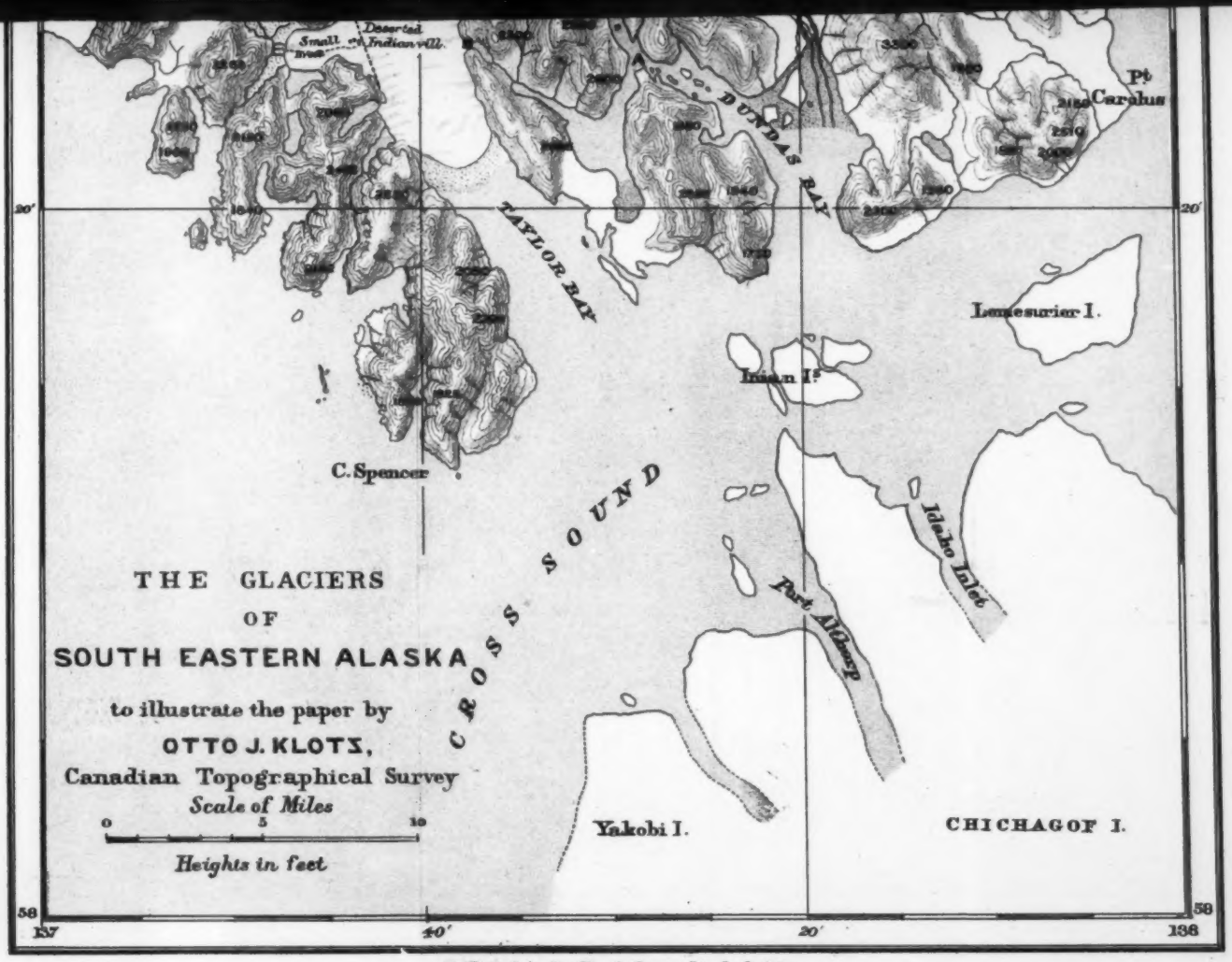
Scale of Miles

0 5 10 20 40 60

Natural scale 1:1,000,000 or 15·78 miles = 1 inch.

Heights in feet.


137
40'
20'
136
59
40
Muir Glacier
GLACIER BAY
Willoughby I.
Berg Bay
Pt Carolus
BRADY GLACIER
Compact perpendicular ice
Deserted Indian vill.
Small moss
Cape Bundas



THE GLACIERS OF SOUTH EASTERN ALASKA

to illustrate the paper by

OTTO J. KLOTZ,
Canadian Topographical Survey

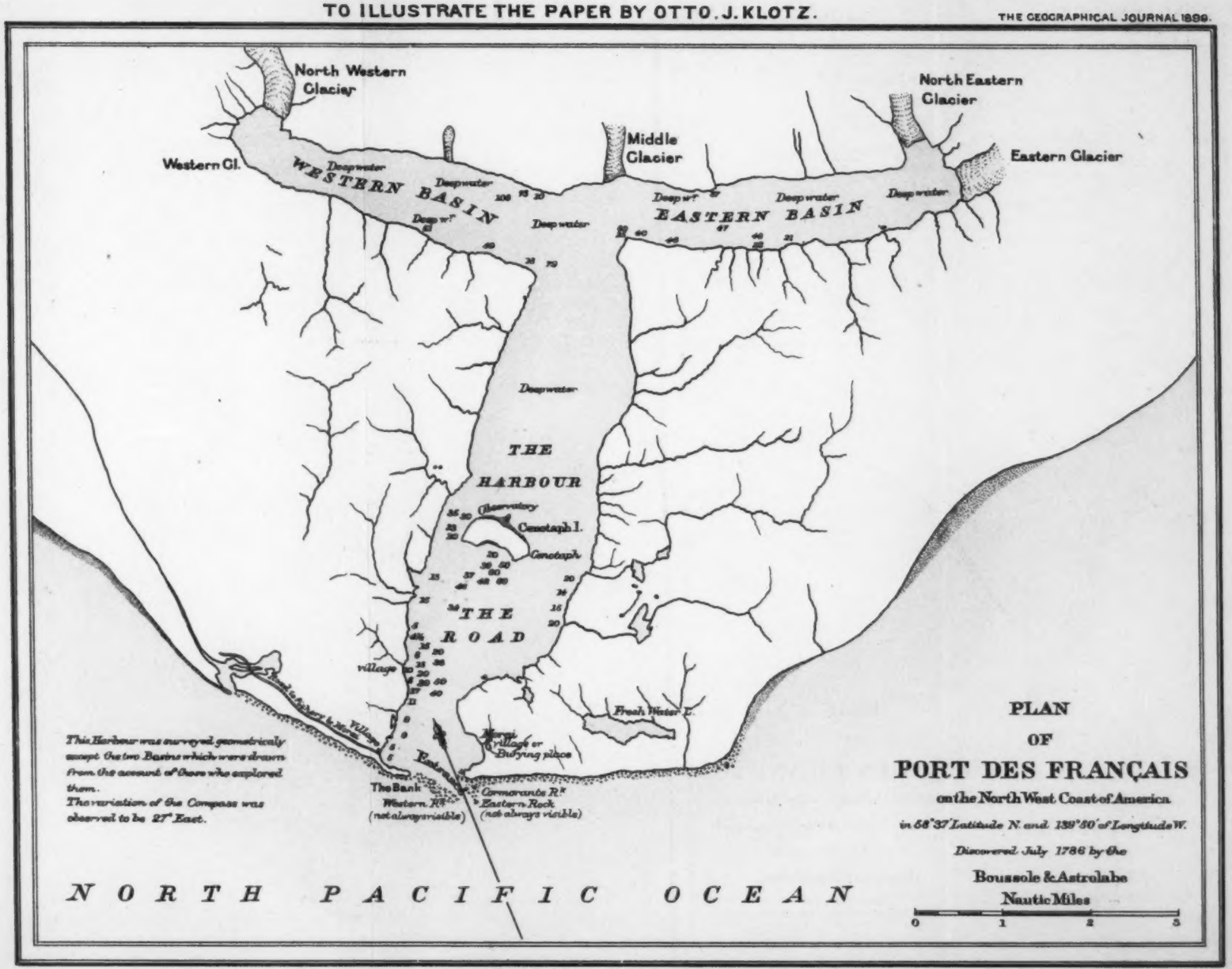
Scale of Miles

0 5 10

Heights in feet

Published by the Royal Geographical Society.

TO ILLUSTRATE THE PAPER BY OTTO J. KLOTZ.



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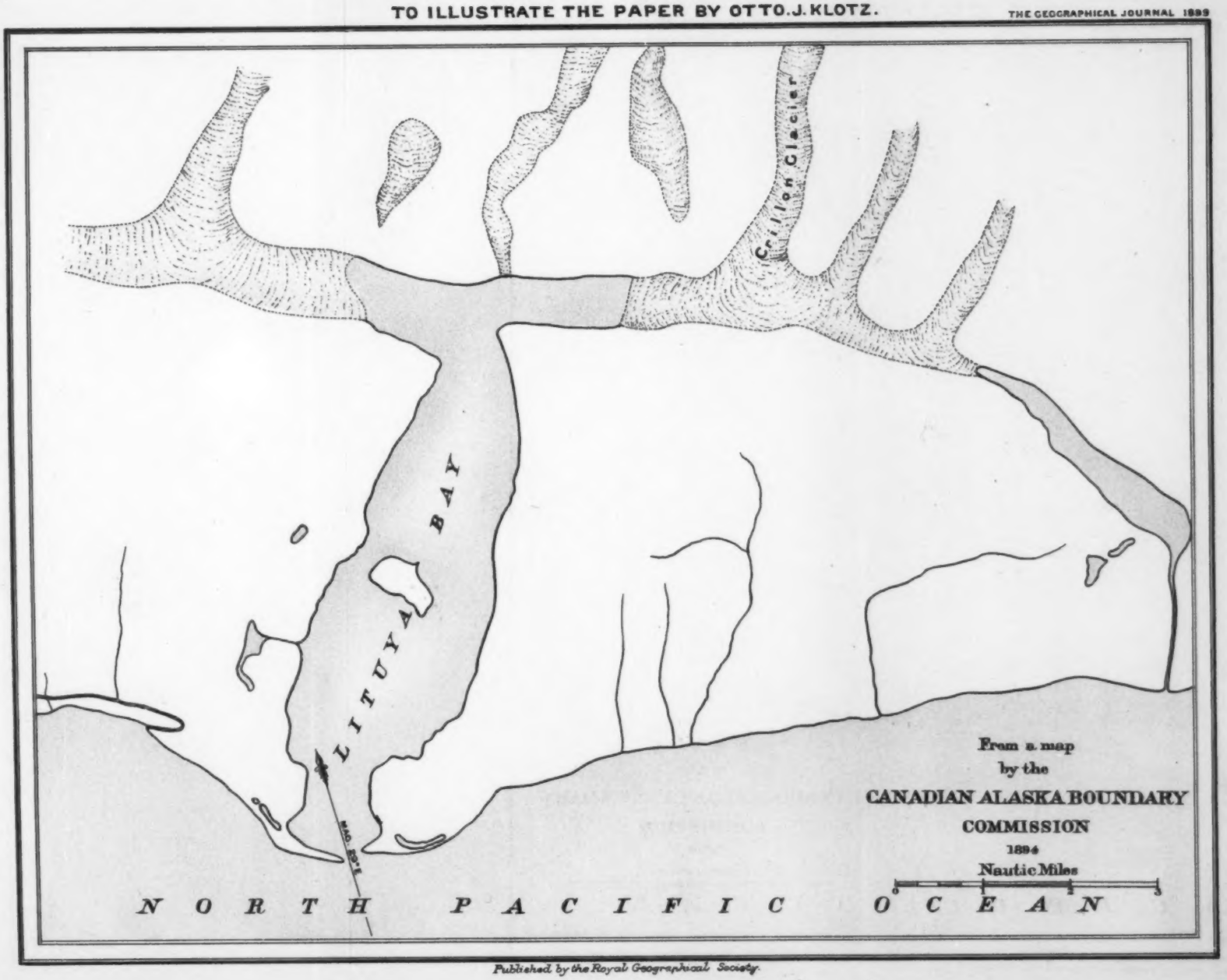

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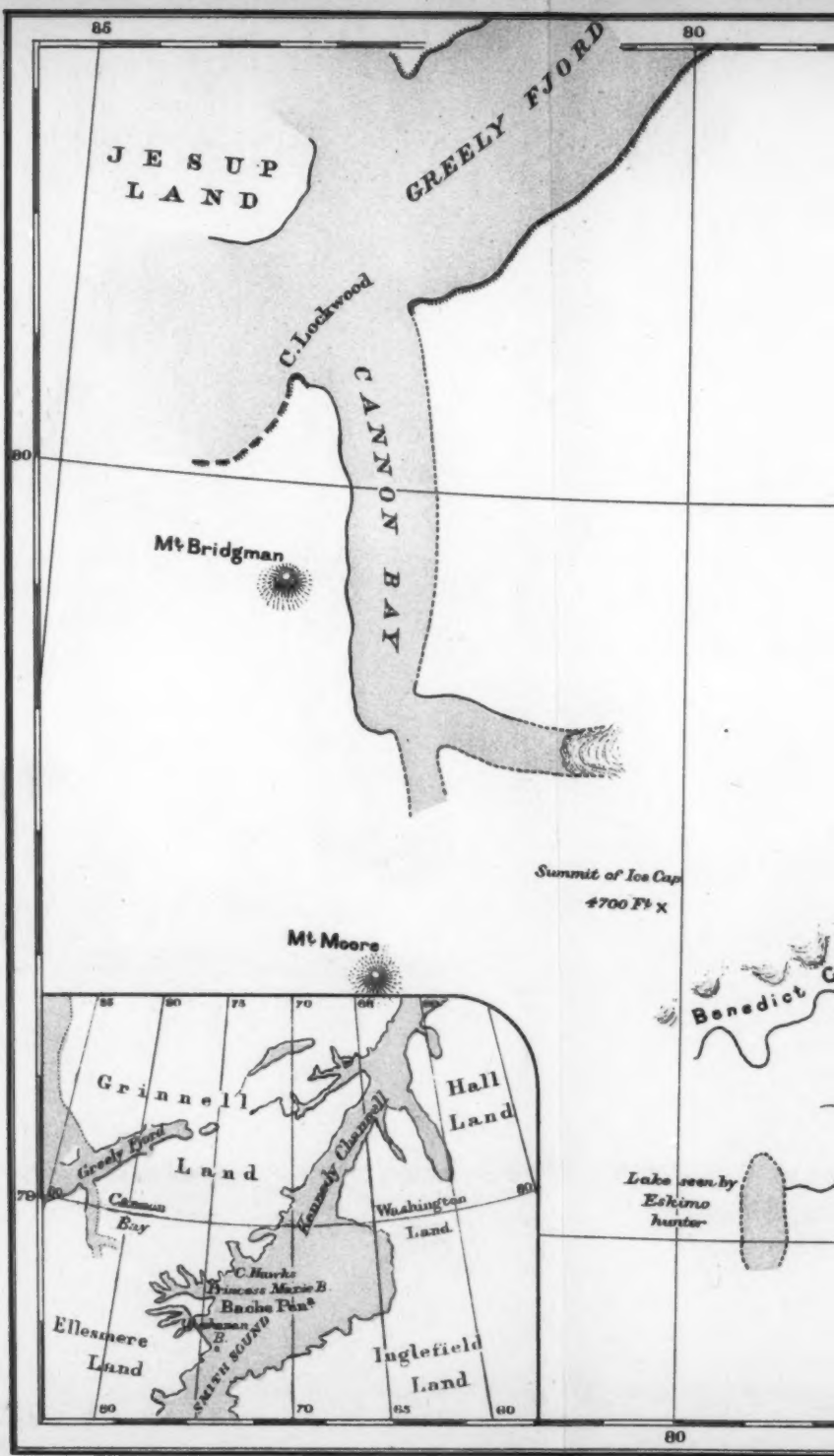

Published by the R

75

SKETCH MAP
OF THE
BUCHANAN BAY, BACHE PENINSULA PRINCESS MARIE BAY REGION OF GRINNELL LAND
BY
LIEUT. R.E.PEARY. C.E, U.S.N.
under the auspices of
THE PEARY ARCTIC CLUB.
1898-99.

Coasts previously mapped shown thus ——————
Features determined by R.E.Peary - ——————

Scale of Miles
0 10 20 30

Nat. scale 1: 1000,000 or 15·78 miles = 1 inch.

the Royal Geographical Society.